

# SOIL SURVEY

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## **Graham County North Carolina**

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**UNITED STATES DEPARTMENT OF AGRICULTURE**  
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In cooperation with the  
**NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION**  
and the  
**TENNESSEE VALLEY AUTHORITY**

# How to Use THE SOIL SURVEY REPORT

**F**ARMERS who have worked with their soils for a long time know about soil differences on their own farms, perhaps about differences among soils on farms of their immediate neighbors. What they do not know, unless soil surveys have been made, is how nearly their soils are like those on experiment stations or other farms, either in their State or other States, where farmers have gained experience with new or different farming practices or enterprises. Farmers of Graham County can avoid some of the risk and uncertainty involved in trying new production methods and plant varieties by using this soil survey report, for it maps and describes the soils in their county and therefore enables them to compare the soils on their farms with soils on which new developments have proved successful.

## SOILS OF A PARTICULAR FARM

All the soils in Graham County are shown on the map placed in the envelope inside the back cover of this report. To learn what soils are on a farm (or any tract of land) it is first necessary to locate it on the map. To do this find the general locality the farm is known to be in and then use roads, streams, villages, dwellings, and other landmarks to locate its boundaries. Remember that an inch on the map equals about three-fourths of a mile on the ground.

The next step is to identify the soils on the farm. Suppose, for example, one finds on a farm an area colored yellow and marked with the symbol *Sa*. Look among the colored rectangles in the margin of the map and find the one with *Sa* printed on it. Just above this rectangle is the name of the soil—State silt loam, undulating phase.

What is State silt loam, undulating phase, like, for what is it used, and to what uses is it suited? For this information turn to the section Soil Types and Phases. How productive is this soil? The answer will be found in table 11. Find in the left-hand column of this table State silt loam, undulating phase, and read in the columns opposite the yields of different crops it can be expected to produce. Compare these yields with those

given in the table for other soils of the county.

What uses and management practices are recommended for State silt loam, undulating phase? For this information read what it said about this soil in the section Soil Types and Phases. Refer also to the section Land Classes and Soil Management, in which soils suited to the same use and management are grouped together. It will be found that State silt loam, undulating phase, is in management group 1-A. What is said about crops, crop rotations, liming, fertilizing, drainage, erosion control, and other management practices for soils of group 1-A will apply to State silt loam, undulating phase.

## SOILS OF THE COUNTY AS A WHOLE

A general idea of the soils of the county is given in the introductory part of the section on Soils of Graham County, which tells about the principal kind of soils, where they are found, and how they are related to one another. After reading this section study the soil map and notice how the different kinds of soils tend to be arranged in different parts of the county. These patterns are likely to be associated with well-recognized differences in type of farming, land use, and land use problems.

A newcomer to the county, especially if he considers purchasing a farm, will want to know about the climate; the types and sizes of farms; the principal farm products and how they are marketed; tenancy; kinds of farm buildings and equipment, churches, schools, roads, and railroads; the availability of telephone and electric services and water supplies; the industries of the county; towns, villages, and population characteristics. Information about all these will be found in the section on General Nature of the Area and in the section on Agriculture.

Those interested in how the soils of the county were formed and how they are related to the great soil groups of the world should read the section on Morphology, Genesis, and Classification of Soils.

This publication on the soil survey of Graham County, N. C., is a cooperative contribution from the—

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# SOIL SURVEY OF GRAHAM COUNTY, NORTH CAROLINA

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United States Department of Agriculture in cooperation with the North Carolina Agricultural Experiment Station and the Tennessee Valley Authority

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<sup>1</sup> Report prepared by William Gettys in 1943 and revised by G. H. Robinson and R. C. Journey in cooperation with the North Carolina Agricultural Experiment Station.

<sup>2</sup> Division of Soil Survey was transferred to Soil Conservation Service on Nov. 15, 1952.

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**G**RAHAM COUNTY, formed in 1872 from part of Cherokee County, is a mountainous area in the extreme southwestern part of North Carolina. Agricultural development has been hampered by distance to outside markets and high transportation costs. The small farms in the narrow valleys produce tobacco for sale, and corn, small grains, hay, and potatoes mainly for home use. Livestock is raised in considerable numbers. The large quantities of timber, tanbark, acid wood, pulpwood, and cross ties harvested from the forests covering about 85 percent of the county are another source of farm income. Presented in the following pages are details concerning a cooperative soil survey made by the United States Department of Agriculture, the North Carolina Agricultural Experiment Station, and the Tennessee Valley Authority for the purpose of determining the best agricultural use of the land in Graham County.

## SOILS OF GRAHAM COUNTY

### GENERAL NATURE OF THE SOILS

About 6 percent of Graham County is at least fairly well suited to crops requiring tillage. Of this 6 percent approximately 2.2 percent is good to excellent cropland; 3.0 percent, fair to good cropland; and about 0.6 percent, poor to fair cropland. About 94 percent of the county is poorly suited to crops requiring tillage; of this, about 55 percent is poorly suited to both crops and pasture. Differences in the characteristics of soils determine differences in suitability. On less than 2 percent of the area the soils are undulating or nearly level; on a little more than 2 percent, gently rolling; on nearly 6 percent, hilly; on about 50 percent, steep; and on about 40 percent, very steep. Approximately 90 percent of the soils have slopes in excess of 30 percent.

The soils of the county are moderately to strongly acid, very low to moderate in organic-matter content, and low to medium in fertility.



The subsoils range in color from light gray through yellow and brown to moderate reddish brown, and in consistence, from loose and friable to slightly sticky.

Practically all of the mountains are forested. Little organic matter has accumulated under forest cover, and most of the soils are therefore low in nitrogen, especially where they have been cleared and cultivated for some time. In addition to their general lack of organic matter, they are deficient in lime and other bases. The heavy annual rainfall has dissolved and leached out most of the bases present in the parent rock. Over a large part of the county soils are unsuitable for general farming because of one or more of the following unfavorable features: Steep relief, shallowness to bedrock, stoniness, relatively low fertility, and degree of erosion.

### SOIL SERIES AND THEIR RELATIONS

Most of the soil series of the county have a prevailingly light-brown to brown subsoil. Only a few have a reddish brown or red subsoil. The textures of the surface soil are mainly loam and silt loam. Over a large part of the county rock fragments, some of which are large boulders, occur on the surface and embedded in the soil. In places, bedrock lies only a few inches below the surface and outcrops are common.

In consistence the surface soils are moderately loose and the subsoils are predominantly friable or brittle. Most of the soils are steep or stony and difficult to till. When the hilly and steep areas are cleared and cultivated they soon become eroded unless properly managed.

For ease of classification and discussion the soil series of the county have been grouped according to the position they occupy in the landscape as follows: (1) Soils of uplands, (2) soils of colluvial lands, (3) soils of stream terraces, and (4) soils of bottom lands.

Uplands—those lands lying above the adjacent stream bottoms—consist of materials derived from the decay of underlying rock. Colluvial lands lie at the base of slopes along intermittent drainageways and in depressions in the uplands; they are derived from materials transported from the higher slopes. Terraces are water-made bench-like lands bordering stream bottoms but are higher lying than the bottoms, hence not subject to flooding. Bottom lands—first bottoms near streams—consist of waterborne materials and are subject to overflow.

Relief, drainage, characteristics of surface soil and subsoil, and source of parent material are given for the soil series of the county in table 1.

#### SOILS OF UPLANDS

The soils of the uplands belong to the Habersham, Porters, Ramsey, and Ranger series (pl. 1, A). They occur chiefly in mountain uplands, where they occupy landscapes of high elevation, long steep slopes, and narrow valleys, but they also occur inextensively in low valley uplands. They have formed from material that weathered from rocks in place. In many areas they are very thin over bedrock, and outcrops of bedrock may appear. Rock fragments of various sizes are scattered over the surface and mixed through the soils in many areas. The slopes range from 10 to 60 percent or more, but the domi-

TABLE 1.—*Important characteristics of the soil series of Graham County, N. C.*

## SOILS OF UPLANDS

Soil series	Relief	Drainage	Surface soil (A horizon) <sup>1</sup>	Subsoil (B horizon)	Source of parent material
Habersham-----	Hilly to steep---	Somewhat excessive or excessive.	Brown to dark-brown friable loam.	Light-red to brownish-red friable clay loam.	Siliceous rock .
Porters-----	do-----	do-----	Light-brown, moderate-brown, or dark-brown friable loam or stony loam.	Yellowish-brown, moderate-brown, or light yellowish-brown friable loam or clay loam.	Acid sedimentary rocks.
Ramsey-----	do-----	do-----	Light brownish-gray, light-brown, light-gray, or yellowish-gray friable silt loam or shaly silt loam.	Dusky-yellow or moderate-brown friable silt loam or silty clay loam containing shale fragments.	Sandstone, shale, and slate.
Ranger-----	Steep-----	Excessive-----	Brownish-gray friable slaty silt loam.	Light-olive or brownish-gray friable loam containing slate fragments.	Slate.

## SOILS OF COLLUVIAL LANDS

Tusquitee-----	Undulating to hilly.	Moderate to excessive.	Light-brown, moderate-brown, or dark-brown friable silt loam or stony loam.	Moderate-brown or dark-brown friable silt loam to silty clay loam.	Colluvium.
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## SOILS OF STREAM TERRACES

Hiwassee-----	Rolling to hilly--	Moderate-----	Dark-brown friable silty clay loam.	Dark reddish-brown stiff, brittle but moderately friable clay or clay loam.	Old alluvium.
State-----	Undulating-----	do-----	Light-brown friable silt loam.	Moderate yellowish-brown friable clay loam.	Moderately recent alluvium.

## SOILS OF BOTTOM LANDS

Buncombe-----	Level to gently undulating.	Excessive-----	Brown loose loamy fine sand.	Yellowish-brown loose loamy fine sand.	Recent alluvium.
Chewacla-----	do-----	Imperfect-----	Dark yellowish-brown friable silt loam.	Brownish-gray, mottled with brown and brownish-black, silt loam; friable when moist, plastic and sticky when wet.	Do.
Congaree-----	Level and nearly level.	Moderate-----	Light-brown friable silt loam	Yellowish-brown friable silt loam.	Do.
Toxaway-----	Level to gently undulating.	Poor-----	Brownish-black friable silt loam.	Mottled light-brown, brown, and gray, sticky to slightly plastic silty clay loam.	Do.
Wehadkee-----	Level and nearly level.	Very poor-----	Brownish-gray, mottled with dark reddish-brown, friable silt loam or silty clay loam.	Mottled gray and brownish-black or yellowish-brown friable, slightly plastic and sticky silt loam or silty clay loam.	Do.

<sup>1</sup> Description for this layer is for the soil in virtually uneroded condition. In eroded areas where subsoil material is mixed with the surface soil to plow depth the color and texture approach those of the subsoil.

nant range is 30 to 60 percent. Only a small part of these soils is cultivated. Corn, grasses, peas, and rye are the main crops. Erosion has been active on many of the tilled areas. The soils are not especially important for crops and pasture but very important for production of timber.

#### HABERSHAM SERIES

The Habersham soils have developed from siliceous rocks, as graywacke and quartzite, on slopes ranging from 10 to 60 percent. They have moderate to very rapid external drainage and moderate internal drainage and are characterized by a brown to dark-brown friable loam surface soil underlain by light-red to brownish-red heavy but friable clay loam subsoil. They are acid to strongly acid, contain very little organic matter, and are low in fertility. Their profile is somewhat shallow, but their water-holding capacity is fair to good.

#### PORTERS SERIES

The Porters soils have formed from material weathered from acid sedimentary rocks and highly metamorphosed graywacke. The surface soil is a light-brown to dark-brown loam or stony loam, 3 to 12 inches thick. It is underlain by a friable and permeable brown to light yellowish-brown loam to clay loam subsoil that extends to depths of 18 to 36 inches but averages less than 30 inches. Surface relief is hilly and steep, the slopes ranging from 15 to more than 60 percent. External drainage is moderate to very rapid. Soils of this series are moderately fertile and have good water-holding capacity but are used principally for forest and pasture or hay. The loam and stony loam, the two types occurring in the county, differ primarily in degree of stoniness.

#### RAMSEY SERIES

Ramsey soils occupy steep slopes of mountain uplands and are formed from sandstone, shale, and slate. Characteristically they have less depth to bedrock and a less well-developed profile than Porters soil. The two types of the series mapped—silt loam and shaly silt loam—differ primarily in quantity of shale fragments on the surface and throughout the profile. The 2- to 8-inch surface layer is light brownish-gray, light-brown, light-gray, or yellowish-gray friable silt loam or shaly silt loam. It is underlain by dusky-yellow or moderate-brown friable heavy silt loam or light silty clay loam that contains many shale fragments. These soils range from 12 to 30 inches deep to bedrock. They are inherently low in fertility and poorly suited to agricultural crops but desirable for forest. External drainage is moderate to very rapid, and internal drainage is rapid.

#### RANGER SERIES

The Ranger soil has developed from the slate and schist generally associated with Nantahala slate. It has formed on slopes ranging from 30 to more than 60 percent and has rapid external and internal drainage. The 6- to 8-inch surface layer is a brownish-gray friable slaty silt loam. The subsoil is a friable loam containing a considerable quantity of small slate fragments and varies from light olive to brownish gray.



## SOILS OF COLLUVIAL LANDS

## TUSQUITEE SERIES

Soils of the Tusquitee series, the only ones in the county on colluvial material, occupy about 6 percent of the county (pl. 1, *B*). They have developed generally on foot slopes of mountains or hills from material washed, slipped, or sloughed from higher elevations. Such accumulations also are on foot slopes near heads of small streams. The colluvial material is a mixture of sand, silt, clay, and rock fragments of varying sizes. Tusquitee soils have a light-brown to dark-brown friable silt loam or stony loam surface soil, 3 to 18 inches thick, underlain by a moderate-brown or dark-brown friable silt loam to silty clay loam subsoil. Depth to bedrock ranges from 20 to 40 inches in most places, but it is much greater in some. The soils are very productive and are used for most crops grown in the area (pl. 2, *A*). Slopes range from 2 to 30 percent. External drainage is very slow to rapid; internal drainage is moderate. In some areas considerable stone occurs on the surface and throughout the profile. Such areas are designated as stony types.

## SOILS OF STREAM TERRACES

The Hiwassee soils have developed from old alluvium, and the State soil from moderately recent alluvium, both on stream terraces. They occupy less than 1 percent of the county. The Hiwassee soils are on high stream terraces, and the State soil is on low terraces.

## HIWASSEE SERIES

The 3- to 8-inch surface layer of Hiwassee soils is dark-brown friable silty clay loam, and the subsoil is dark reddish-brown stiff and brittle but moderately friable clay or clay loam, 26 to 50 inches thick. The underlying material is dark-orange sandy clay, generally containing rounded or water-worn gravel and cobblestones (pl. 2, *B*). External drainage is moderate to rapid; internal drainage, moderate to slow. The fertility is high or may be brought up readily, and the soils are very productive for most crops, especially small grains, grasses, and legumes.

## STATE SERIES

The 6- to 10-inch surface layer of the State soil is a light-brown friable silt loam. It is underlain by a moderate yellowish-brown friable clay loam subsoil 15 to 30 inches thick. External drainage is very slow to slow, and internal drainage is moderate. Fertility is medium to good, and response to management is excellent. The soil is limited in extent but for production of crops is important in this county.

## SOILS OF BOTTOM LANDS

Soils of bottom lands include those of the Buncombe, Chewacla, Congaree, Toxaway, and Wehadkee series, all derived from recently deposited alluvial material and lying on slopes ranging from 0 to 3 percent. They are normally developed in narrow strips near streams and usually are subject to overflow during periods of high water. Surface drainage is very slow or slow, but internal drainage ranges

from very slow to rapid. The soils are not extensive but very important because they can be farmed intensively to truck and other cash crops or used for corn.

#### BUNCOMBE SERIES

The Buncombe soil characteristically has a brown loose loamy fine sand surface soil 6 to 10 inches thick, and underlying that, a yellowish-brown loose loamy fine sand subsoil. In color and texture the profile layers differ little or none. The soil ranges from 20 to 40 inches deep. The underlying material, usually stratified, contains sand, gravel, and some finer material. The soil has very slow surface and rapid internal drainage, is relatively low in fertility, and is usually somewhat droughty.

#### CHEWACLA SERIES

The Chewacla soil has a dark yellowish-brown friable silt loam surface soil, 7 to 12 inches thick, and a brownish-gray, mottled with brown and brownish-black, friable silt loam subsoil 10 to 24 inches thick. It differs from the Congaree soil primarily in having poorer internal drainage and in being mottled. Under natural drainage, the soil seems better suited to hay and pasture than to other uses. Under artificial drainage or in dry seasons, however, corn, truck crops, and, occasionally, small grains can be grown very satisfactorily.

#### CONGAREE SERIES

The Congaree soil has a light-brown friable silt loam surface soil, 6 to 8 inches thick, underlain by a yellowish-brown friable silt loam subsoil, 20 to 32 inches thick. Below the subsoil is a layer of yellowish-gray fine sand and gravel that continues to the water table. The soil is relatively micaceous in many places. External drainage is very slow to slow, and internal drainage is moderate. The soil is moderately fertile to very fertile, has good water-holding capacity, responds well to good management, and can be used intensively for most of the crops grown in the county.

#### TOXAWAY SERIES

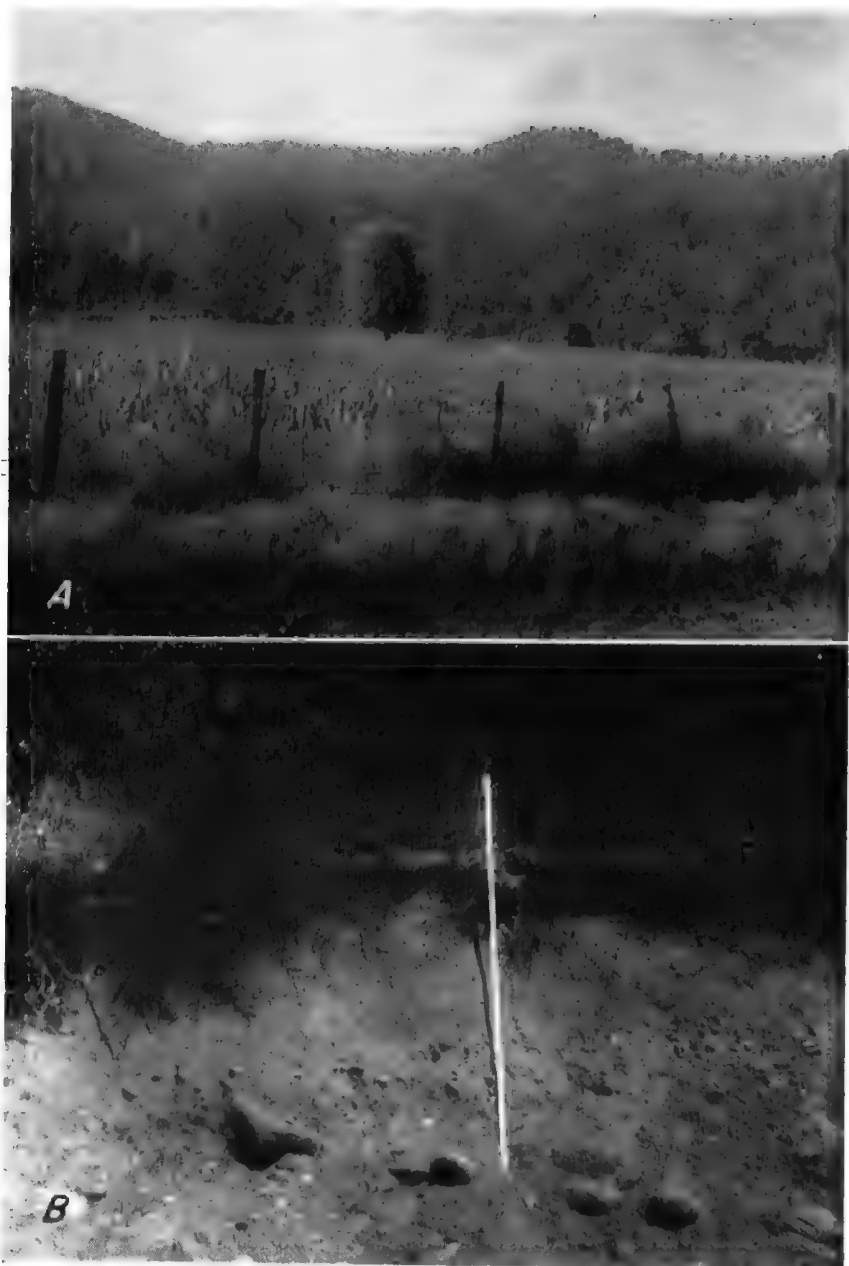
The Toxaway soil differs from the Congaree in having a nearly black surface soil and in containing considerable organic matter. It has much less favorable drainage than the Congaree soil and at times may be difficult to manage. The surface soil is a brownish-black friable silt loam, 7 to 9 inches thick. It is underlain by a mottled light-brown and gray sticky to slightly plastic subsoil, 15 to 24 inches thick. The mottling in the subsoil becomes more pronounced with increasing depth. The soil is somewhat limited in suitability for crops, especially because of its naturally poor drainage, but is fairly productive and responds well to treatment when adequately drained. Drained areas can be used for corn, peas, soybeans, and some truck crops.

#### WEHADKEE SERIES

The Wehadkee soil has developed in swales and lower lying parts of river bottoms. It has a 5- to 10-inch mottled brownish-gray and dark



- A,** Cut-over deciduous forest on Stony rough land (Porters and Ramsey soil materials) and Ramsey shaly silt loam, steep phase. These soils are very extensive in Graham County. (Courtesy of TVA.)
- B,** Cove adjacent to Santeetlah Lake. Smooth tillable Tusquitee soils on floor of cove; Habersham soils on partly cleared foot slopes; and chiefly Stony rough land (Porters and Ramsey soil materials) on steep forested areas in background. Most of the soils of Graham County suited to crops and pasture occur in coves such as this. (Courtesy of TVA.)



**A**, Tusquitee silt loam, undulating phase, a productive soil well suited to pasture and a wide variety of crops, occupies many mountain coves.

**B**, Hiwassee silty clay loam, eroded rolling phase, one of the more desirable soils for crops, occurs on old stream benches or terraces and is underlain by beds of gravelly material. (Courtesy of TVA.)



reddish-brown friable silt loam surface soil. The subsoil is mottled gray and brownish-black or yellowish-brown massive but friable silt loam or silty clay loam, 20 to 25 inches thick. The water table is often only 18 to 20 inches below the surface. Wehadkee soil is moderately fertile and if it is adequately drained and receives good management, produces corn, truck crops, and small grains satisfactorily. Under natural drainage the soil is used primarily for pasture and grass hay. Because of poor outlets and other difficulties very little of the soil has been artificially drained.

### SOIL TYPES AND PHASES

In the following pages the soils of Graham County are described in detail and their agricultural relations are discussed. The soils are arranged alphabetically by series name and identified by the same symbols as are used on the soil map (cover page 3). The acreage and proportionate extent of the soils will be found in table 2, their location and distribution on the soil map, and their use and management in the section on Soil Uses, Management, and Productivity.

TABLE 2.—*Acreage and proportionate extent of the soils mapped in Graham County, N. C.*

Soil	Acres	Percent
Buncombe loamy fine sand.....	366	0.2
Chewacla silt loam.....	1,502	.8
Congaree silt loam.....	506	.3
Habersham loam:		
Eroded hilly phase.....	1,010	.5
Eroded steep phase.....	195	.1
Hilly phase.....	228	.1
Severely eroded hilly phase.....	129	.1
Steep phase.....	146	.1
Hiwassee silty clay loam:		
Eroded hilly phase.....	139	.1
Eroded rolling phase.....	239	.1
Porters loam:		
Eroded hilly phase.....	515	.3
Eroded steep phase.....	2,786	1.5
Hilly phase.....	449	.2
Steep phase.....	8,490	4.4
Porters stony loam:		
Eroded hilly phase.....	150	.1
Eroded steep phase.....	1,112	.6
Hilly phase.....	1,086	.6
Steep phase.....	53,140	28.1
Ramsey shaly silt loam:		
Eroded hilly phase.....	174	.1
Eroded steep phase.....	1,576	.8
Hilly phase.....	225	.1
Steep phase.....	22,741	12.0
Ramsey silt loam:		
Eroded steep phase.....	265	.1
Hilly phase.....	151	.1
Steep phase.....	679	.4
Ranger slaty silt loam, steep phase.....	1,947	1.0
State silt loam, undulating phase.....	704	.4
Stony colluvium (Tusquette soil material).....	419	.2
Stony rough land (Porters and Ramsey soil materials)...	74,638	39.4

TABLE 2.—*Acreage and proportionate extent of the soils mapped in Graham County, N. C.—Continued*

Soil	Acres	Percent
Toxaway silt loam.....	66	( <sup>1</sup> )
Tusquitee silt loam:		
Hilly phase.....	249	0. 1
Rolling phase.....	2, 078	1. 1
Undulating phase.....	322	. 2
Tusquitee stony loam:		
Eroded hilly phase.....	253	. 1
Hilly phase.....	6, 345	3. 3
Rolling phase.....	3, 205	1. 7
Undulating phase.....	547	. 3
Wehadkee silt loam.....	668	. 4
Total.....	<sup>2</sup> 189, 440	100. 0

<sup>1</sup> Less than 0.1 percent.

<sup>2</sup> This figure does not include 3,249 acres inundated by the Fontana Reservoir.

**Buncombe loamy fine sand** (0–3% slopes) (BA).—This alluvial soil occurs in small narrow strips near streams in the first bottoms. It is subject to overflow and has very slow external and rapid internal drainage. The surface layer, a brown loose loamy fine sand, is underlain by a yellowish-brown loose loamy fine sand subsoil. The subsoil differs very little from the surface soil, though the sand grains usually become coarser with depth and the layer may be considerably stratified. This soil is closely associated with Congaree silt loam. Most areas have been cleared. The native vegetation probably included pine, birch, and sycamore.

Characteristic profile in a cultivated area:

0 to 10 inches, brown loose friable loamy fine sand; very little organic matter.  
10 to 30 inches, yellowish-brown loose loamy somewhat incoherent fine sand.  
30 inches +, loose sand to loamy sand and gravel, with increasing depth becoming stratified and usually coarser.

Included with this soil are about 25 acres of Buncombe gravelly loamy fine sand, which is not mapped separately in the county. These areas are near Rattler Ford and Santeetlah Creek and differ from the loamy fine sand only in content of gravel.

*Use and management.*—Where Buncombe loamy fine sand has not been recently treated it is medium acid (pH about 5.3). It is low in calcium, magnesium, nitrogen, phosphorus, and potassium.<sup>3</sup> Water, air, and roots penetrate readily, but the soil is somewhat droughty unless well supplied with green manure or other organic materials. The land is easily worked and suitable for use of light farm machinery. It leaches fairly rapidly because of its sand content and therefore should have more frequent applications of organic matter, lime, and fertilizer than the finer textured soils. Runoff is not a problem.

About 24 percent of Buncombe loamy fine sand is used for crops and 35 percent for pasture; 29 percent is idle cropland, and 12 percent

<sup>3</sup> Average results of quick-test laboratory analyses of several soil samples.

is woodland. The principal crops are corn, rye, and truck vegetables. Yields are relatively low unless liberal applications of fertilizer and green manures are made.

**Chewacla silt loam** (0-3% slopes) (Ca).—This alluvial soil is in first bottoms along many streams. The parent material is generally of local origin, having been washed from soils of the adjacent slopes. The subsoil is characteristically mottled in the upper part, and mottling becomes more pronounced with increasing depth. The water table is high, often being at a depth of 20 to 30 inches. Although most areas have been cleared, it is evident that the native vegetation included wild cherry, buckeye, maple, and oak trees and an undergrowth of briers and weeds.

**Profile description :**

- 0 to 10 inches, dark yellowish-brown friable silt loam; fine crumb structure.
- 10 to 24 inches, brownish-gray silt loam mottled with brown and brownish black; friable when moist but moderately plastic and sticky when wet; breaks into irregularly shaped lumps under force.
- 24 inches +, gray, spotted with reddish-brown, silt loam to silty clay loam; somewhat plastic and sticky when wet; grayer with depth; in places underlain by loose gravel and sand or silt and clay of massive structure; evidence of stratification; water generally within 30 inches of surface.

There is some variation from area to area in depth to the water table, in degree of mottling, and the depth at which mottling begins. Subsoil textures vary considerably according to the accidents of deposition.

Chewacla silt loam is acid to strongly acid but fairly well supplied with plant nutrients and organic matter. It is subject to overflow and in its natural state is often too wet for satisfactory cropping. The soil has very slow external drainage and slow internal drainage.

*Use and management.*—When artificially drained this soil is well suited to corn, small grains, hay, and pasture. The more poorly drained areas, usually too near the stream level for artificial drainage, can be used for hay or pasture. Where necessary, the drained soil may be handled in relatively short rotations of corn, truck crops, and small grain.

Chewacla silt loam responds well to lime and fertilizer and is easy to cultivate. An estimated 55 percent is now in crops, 10 percent in cropland left idle, 4 percent in pasture, and 31 percent in forest.

**Congaree silt loam** (0-2% slopes) (Cb).—Most of this soil occurs in association with Chewacla and Wehadkee soils. Recent alluvium in first bottoms along streams is the parent material. Relief is nearly level to level. External drainage is very slow to slow, and internal drainage is moderate. Although all areas have been cleared and cultivated at some time, the native vegetation probably included oak, yellow-poplar, white ash, wild cherry, sweetgum, maple, dogwood, and birch.

**Profile description :**

- 0 to 8 inches, light-brown friable silt loam: low organic-matter content; moderate fine crumb structure.
- 8 to 32 inches, strong yellowish-brown friable silt loam; weak granular structure.
- 32 inches +, dark yellowish-brown fine sandy loam to silt loam somewhat mottled or spotted with brownish gray, grading into loose incoherent sand and gravel at variable depths, generally within 50 inches.

Both the surface soil and subsoil contain some mica. Variations in the thickness and texture of the soil layers are caused primarily by stratification of the alluvial material from which the soil is derived. Areas near the streams usually have a coarser textured subsoil than those farther away.

When not treated with lime or fertilizers, the soil is medium acid (pH about 5.4). It has a moderate supply of calcium, low supplies of magnesium, phosphorus, potash, and organic matter, and a good water-holding capacity. It is friable and permeable, responds well to treatment, and is easily conserved. It is considered highly desirable for crops, and can be used intensively for corn, small grains, soybeans, potatoes, and truck crops, from which good yields can be expected.

**Habersham loam, hilly phase (15-30% slopes) (Ho).**—Hilly and steep uplands are occupied by this soil that formed from sedimentary rocks consisting mainly of fine-grained sandstone, conglomerate, and graywacke. The areas occur principally in the central part of the county and are associated with Ramsey and Porters soil, more particularly where those soils occur on the lower ridges and lower mountains. External drainage is moderate to rapid; internal drainage, moderate.

The soil is characterized by a moderate-brown to dark brown friable loam surface layer, underlain by a light to brownish-red friable light clay loam subsoil. It is usually strongly acid (pH 4.9), low in calcium phosphorus, and potash, and medium in organic-matter content. The native vegetation consists mainly of white, post, red, and black oaks, hickory, sourwood, maple, yellow-poplar, white and shortleaf pines, and laurel, huckleberry, and other low shrubs.

Characteristic profile in a wooded area:

- 0 to 5 inches, brown to yellowish brown friable loam containing a considerable quantity of well-decomposed organic material; thin layer of partly decomposed organic matter on the surface.
- 5 to 15 inches, dark-brown friable loam that breaks easily into irregularly shaped lumps having medium nut structure; many roots.
- 15 to 26 inches, light-red to brownish-red friable clay loam containing a few rock fragments; medium nut structure.
- 26 inches +, reddish-brown clay loam material mixed with medium-gray and strong yellowish-brown partly disintegrated graywacke rock underlain by the unweathered rock.

Approximately 3 acres of Habersham stony loam, hilly phase, are included with this phase because of limited extent and similarity. The included soil differs only in that it has a considerable quantity of stone scattered over the surface and mixed in the soil mass. Other variations are chiefly in the depth of the profile over rock. In places the subsoil color ranges from brown or pale reddish brown to bright red, and the texture from fine sandy clay to clay loam.

*Use and management.*—Nearly all of Habersham loam, hilly phase, is in forest, but if it becomes necessary to crop some areas, moderate yields of corn, rye, hay, and pasture can be expected under adequate management. The soil should respond well to lime and fertilizer. Addition of organic material by turning under legume crops would probably be very beneficial. If the land is cultivated, cover crops should be used two-thirds to three-fourths of each rotation



period. Since the soil is subject to erosion, contour tillage, strip cropping and similar practices are essential to check runoff.

**Habersham loam, eroded hilly phase (10-30% slopes) (H<sub>A</sub>).—**Areas that ordinarily would be mapped as Habersham loam, hilly phase, but now moderately eroded as a result of being cleared and cultivated, make up this phase. It differs from Habersham loam, hilly phase, in having a slightly lower organic-matter content and a shallower surface soil that is somewhat finer in texture because of mixture with the clay loam subsoil through tillage. The soil is associated with other Habersham soils and with Porters and Ramsey soils. External drainage is rapid; internal drainage, moderate. The surface soil is brown to reddish-brown friable loam. The subsoil consists of light-red to brownish-red friable clay loam to sandy clay loam. The soil is acid, and low in calcium, magnesium, phosphorus, and potash but moderately high in organic matter. It is permeable to water, roots, and air and has good water-holding capacity.

Some variations occur in the color and thickness of the surface soil and in the color of the subsoil. Approximately 14 acres of Habersham stony loam, eroded hilly phase, and about 5 acres of Habersham loam, eroded rolling phase, have been included because of their limited extent. The included soils have not been mapped separately in the county and differ from this eroded hilly soil only in degree of slope or in the presence of considerable stone on the surface and throughout the profile.

*Use and management.*—About 40 percent of Habersham loam, eroded hilly phase, is used for crops. About 23 percent is idle cropland, and 37 percent is in pasture. The principal crops are small grains, peas, lespedeza, hay, and some corn. Yields are usually somewhat low, but with good management, including adequate applications of lime and fertilizer, moderate to good yields can be expected. The soil is fairly well suited to small grains, hay, and pasture. When areas of it are planted to a clean-cultivated crop, care must be exercised to prevent further damage by erosion.

**Habersham loam, severely eroded hilly phase (15-30% slopes) (H<sub>B</sub>).—**From Habersham loam, eroded hilly phase, this soil differs chiefly in being more severely eroded. It has rapid external drainage and moderate internal drainage. The surface soil, or plow layer, consists of light reddish-brown to brownish-red friable loam to light clay loam. It is underlain by a strong-brown to light-red friable fine sandy clay to clay loam that continues to a depth of 20 to 24 inches. Because much of the original surface soil has been lost and that remaining has been mixed with the upper subsoil by plowing, both the surface soil and subsoil are shallower than those of the hilly phase and the surface soil is finer textured and browner. External drainage is also more rapid. At least 75 percent of the original surface soil has been lost, chiefly through sheet erosion, and some gullies are also present. This phase is associated with other members of the Habersham series.

*Use and management.*—Most of the soil is now either in pasture or lies abandoned and idle. It is low in both organic matter and fertility, moderately to strongly acid, and very susceptible to further damage by erosion. Because they are severely eroded, most areas

should be planted to trees. Where the soil must be cultivated it should receive liberal quantities of lime and fertilizer, and crops as legumes or rye should be grown and plowed under to increase the organic-matter content. With use of careful management practices, including contour tillage and strip cropping, corn, wheat, rye, clover, and lespedeza can be grown in long rotations with grasses and legumes.

**Habersham loam, steep phase (30–60% slopes) (He).**—Steeper slopes, a somewhat more shallow profile, and, in many places, slightly less well differentiated subsoil layers distinguish this soil from the hilly phase. The friable medium-brown loam surface soil is underlain by a strong-brown to light-red friable fine sandy clay loam to clay loam subsoil.

This soil is associated with other Habersham soils and with those of the Ranger and Porters series. External drainage is rapid; internal drainage, moderate. Practically all areas are forested with white, post, red, and black oaks, hickory, sourwood, dogwood, maple, yellow-poplar, white pine, shortleaf pine, laurel, and various shrubs and bushes.

The soil is acid, low in phosphorus, potash, and calcium, and medium in supply of organic matter. It is permeable to roots, water, and air and has moderate water-holding capacity. Unfavorable slopes make this phase poorly suited to cultivated crops, but it is fair to good for forest. Should it be necessary to clear areas for crops, yields probably would be low and careful management would be required to prevent serious damage by erosion.

**Habersham loam, eroded steep phase (30–60% slopes) (Hn).**—All of the phase has been cleared and cultivated, and 50 to 75 percent of the original surface layer has been lost through erosion. The subsoil is within plow depth over half or more of each area. The areas occur on steeper parts of the mountain uplands and are associated with Porters and Ranger soils and Stony rough land (Porters and Ramsey soil materials). The soil differs from uneroded hilly Habersham loam in having steeper slopes, somewhat more shallow and less well differentiated profile layers, a slightly finer textured surface soil, and generally a deeper brown surface color. External drainage is rapid to very rapid, and internal drainage is moderate. The surface soil is brown to reddish-brown friable loam. The subsoil is strong-brown to light-red friable clay loam or fine sandy clay loam.

Because of limited extent, approximately 40 acres of Habersham loam, severely eroded steep phase, 10 acres of Habersham stony loam, eroded steep phase, and 7 acres of Habersham stony loam, severely eroded steep phase, have been included with this eroded steep phase. These included areas differ from this soil in degree of erosion or in quantity of stone on the surface and throughout the profile. They are not mapped separately anywhere in the county.

*Use and management.*—Approximately 73 percent of Habersham loam, eroded steep phase, is used for pasture; 27 percent is idle cropland. Because of steep slopes and susceptibility to erosion, the soil is best suited to forest. Some areas, however, may be expected to produce moderate pasture yields if carefully managed. The soil is moderately to strongly acid, somewhat low in organic matter and

fertility, and very susceptible to further erosion. It responds well to applications of lime and fertilizer.

**Hiwassee silty clay loam, eroded rolling phase (4-15% slopes) (H<sub>6</sub>).—**Old alluvium on high stream terraces is the material on which this phase developed. The soil is associated with other Hiwassee soils and with State silt loam, undulating phase. It is characterized by a dark-brown friable silty clay loam surface soil and a dark reddish-brown stiff brittle clay to clay loam subsoil. External drainage is moderate to rapid; internal drainage, moderate to slow. Nearly all areas have been cleared and cultivated. The native vegetation probably included black, red, post, and white oaks, maple, black cherry, birch, sourwood, ash, dogwood, shortleaf pine, and some pitch pine.

Profile in an area north of Robbinsville:

0 to 6 inches, dark-brown friable silty clay loam; weak granular structure.

6 to 22 inches, dark reddish-brown clay to heavy clay loam; stiff and brittle, but with pressure crumbles into small irregularly shaped lumps.

22 to 36 inches + dark-orange friable sandy clay or fine sandy clay mottled with moderate orange; contains a few pieces of rounded gravel; underlying material, gravel weakly cemented by sand and clay.

Some variations occur in the surface soil color and in the thickness of the subsoil. Sheet erosion has removed 40 and 75 percent of the original surface soil. For the most part the few gullies that have formed usually cannot be obliterated by ordinary tillage but can be crossed with commonly used farm machinery.

The soil is moderately to very fertile, somewhat low in organic matter, medium to strongly acid (average pH about 5.3), and responds readily to treatment. It is permeable to plant roots, moisture, and air and its water-holding capacity is good.

A few small areas of Hiwassee silty clay loam, undulating phase, and Hiwassee silty clay loam, slightly eroded undulating phase, have been included. The included soils are closely associated with this phase and are similar in most profile characteristics but less eroded. They have not been mapped separately in this county.

*Use and management.*—Nearly all areas of Hiwassee silty clay loam, eroded rolling phase, have been cleared and used for corn and small grains. An estimated 85 percent is now used for crops and 3 percent for pasture; about 12 percent is lying idle.

The soil is well suited to corn, small grains, clover, and burley tobacco. With careful management good to excellent yields can be expected. Rotations including leguminous hay or cover crops are advisable for maintaining the organic matter, increasing nitrogen, and controlling runoff. Contour tillage and strip cropping should be used where needed to support measures for water control.

**Hiwassee silty clay loam, eroded hilly phase (15-30% slopes) (H<sub>r</sub>).—**This phase, occurring on the steeper slopes of high terraces, has rapid external drainage and moderate to slow internal drainage. It differs from Hiwassee silty clay loam, eroded rolling phase, in having steeper slopes, more rapid external drainage, a somewhat more shallow profile, and greater susceptibility to erosion. The soil has been materially injured by erosion. Between 50 to 75 percent of the original surface soil has been removed, and on approximately half of each area the subsoil is within plow depth. The 3- to 5-inch

surface layer, a dark-brown friable silty clay loam, owes its finer texture primarily to mixing of the original surface soil with part of the upper subsoil. The underlying subsoil is dark reddish-brown stiff, brittle clay to clay loam.

The phase is medium to strongly acid (average pH about 5.3), low in calcium, magnesium, and phosphorus, and high in potash. Its supply of organic matter is moderate. Occasionally there are a few rounded pieces of gravel on the surface. Water, air, and roots readily penetrate the soil, and water-holding capacity is good. There are a few gullies, which in a few areas occur at intervals of about 100 feet. These gullies usually can be crossed with ordinary farm machinery.

Included with this phase are about 3 acres of Hiwassee silt loam, hilly phase, which is not separately mapped in the county and differs from this soil in having a slightly coarser and somewhat thicker surface soil.

*Use and management.*—Approximately 21 percent of Hiwassee silty clay loam, eroded hilly phase, is used for crops and 16 percent for pasture; 63 percent is idle cropland. Cultivated crops should not be planted more than 1 year out of 4 or 5; grass, legumes, and other close-growing crops should occupy the soil as much of the time as practicable. Contour tillage and strip cropping should be thoroughly considered. The soil responds well to lime and fertilizer, and especially to additions of manure and green manure. Under good management, moderate to very good yields can be expected. Tillage must be carried on within a relatively narrow range of moisture content because the soil is fine-textured. In a few places the plow layer is relatively sticky when wet and clings to tillage implements. When dry the plow layer is somewhat hard in many places.

**Porters loam, steep phase (30–60% slopes) (Pd).**—Like other soils of the series in Graham County, this phase consists of material weathered from sandstone and graywacke of the Great Smoky conglomerate. It differs from Porters soils in many other counties in western North Carolina, where the predominant parent rocks are of granite, gneiss, and schist. It covers a large area, mainly in the central part of the county. External drainage is rapid to very rapid, and internal drainage is moderate. The natural fertility is moderately high compared with that of other soils in the county. The soil is medium to strongly acid, easily permeable, and somewhat deeper to bedrock than the associated Ramsey and Ranger soils.

Nearly all of this land is in forest consisting chiefly of white, post, black, and red oaks, and hickory, mixed with some shortleaf and white pines, sourwood, maple, and yellow-poplar. An undergrowth of mountain-laurel, rhododendron, huckleberry, blackberry, and buckberry is common.

**Profile description:**

- 0 to 6 inches, light-brown to brown friable loam; soft granular structure; surface inch dark brown under native forest.
- 6 to 15 inches, yellowish-brown friable clay loam readily broken into irregularly shaped lumps.
- 15 to 22 inches, brownish-yellow friable clay loam containing a few rock fragments.



22 to 28 inches, a mixture of light yellowish-brown friable clay loam and medium-gray and strong yellowish-brown rock fragments; underlying layer, bedrock.

In places, especially on concave slopes or in swalelike positions, the surface 8 to 10 inches is somewhat darker and thicker. The color in these places is brown or dark brown, or in a few localities, nearly black. The depth to bedrock ranges from about 18 to 36 inches.

*Use and management.*—Chiefly because of a strong slope, this soil is not well suited to crops requiring tillage. Nevertheless, its natural fertility and favorable moisture relations make much of it well suited to permanent pasture. Some fertilization, especially with phosphorus, and moderate applications of lime can be expected to improve the quantity and quality of pasture vegetation.

Where conditions on the farm require that areas of this soil be used for crops, particularly careful management is necessary if productivity is to be maintained. Where use for crops is necessary, long rotations consisting chiefly of fall-sown small grains and legume-and-grass hay crops are best suited. Maintaining a high state of fertility and an adequate supply of lime will be of great value in obtaining good yields and a stability of the soil under this use. Tillage should be on the contour, and in places strip cropping is probably feasible.

**Porters loam, eroded steep phase (30–60% slopes) (P<sub>B</sub>).**—Erosion has followed clearing and cultivating of this soil. Most areas have lost 40 to 75 percent of the original surface soil, and in spots the upper subsoil may be exposed. The plow layer consists of the remainder of the original surface soil mixed with the subsoil. The subsoil, however, is very friable and therefore neither the working qualities nor the fertility of the soil has been injured greatly. Slight injury has occurred, however, because erosion has decreased the total depth of the soil over rock and made control of surface runoff a little more difficult.

This eroded steep phase has lighter brown surface soil than the uneroded Porters soils, and in places, a slightly finer texture. Areas of it are relatively widely scattered throughout the county.

According to averages of several tests, this soil is strongly acid (pH about 5.1); low in calcium, magnesium, phosphorous, and potash; and medium in organic matter. It is friable, readily permeable, relatively free of stone, and good in water-holding capacity.

Included with this phase because of limited extent are 54 acres of Porters loam, severely eroded steep phase (not separately mapped in this county), and a small acreage of Porters stony loam, eroded steep phase. The inclusions are similar to this phase in most profile characteristics but differ in degree of erosion or in the quantity of stone on the surface and throughout the profile.

*Use and management.*—An estimated 24 percent of Porters loam, eroded steep phase, is in crops, and 35 percent in pasture. About 41 percent is idle cropland. Steep slopes make this land poorly suited to cultivated crops. On farms where it must be used for tilled crops, the general practices of good soil management will be necessary to maintain production. The soil should not be used for row crops more than once in 5 to 8 years. Strip cropping and contour tillage should be thoroughly considered as means of controlling runoff. In nearby

counties Porters soils, though eroded, are considered very desirable for pasture. They respond very well to lime, phosphate, and other amendments. With some control of grazing and the addition of amendments many idle areas in this county should be able to support some livestock.

**Porters loam, hilly phase (15–30% slopes) (Pc).**—Milder slopes, a slightly thicker surface soil, a little deeper subsoil, and less rapid external drainage distinguish this soil from the steep phase. The soil is permeable and friable throughout and excellent in water-holding capacity. Variations in the color and texture are slight, but in some places on the points of ridges or in other localities the soil is somewhat less deep than normal. The 8- to 12-inch surface soil is brown to dark-brown friable porous loam containing a considerable quantity of organic matter. The subsoil, a moderate-brown friable porous loam or clay loam, grades into partly weathered slate, graywacke, or sandstone at about 28 inches. Bedrock is generally at a depth between 35 and 50 inches.

Included with this soil is a limited acreage of Porters stony loam, hilly phase, which differs in having a considerable quantity of stone on the surface and throughout the profile. These included areas are relatively small and scattered.

*Use and management.*—Most of the areas of Porters loam, hilly phase, are in forest, but those accessible probably could be cleared and used for pasture and hay or even for row crops grown in long rotations. The forest consists of white, post, black, and red oaks, dogwood, sourwood, yellow-poplar, maple, and hickory. Tree growth is good. The undergrowth consists of laurel, rhododendron, huckleberry, and galax.

The soil has moderate to good fertility. It is strongly to very strongly acid and responds readily to lime and fertilizer. There is reason to believe that pasture, hay, small grains, corn, burley tobacco, and truck crops would give satisfactory returns under good management. Care would be necessary to control runoff and prevent damage by erosion. A clean-cultivated crop should not be grown more often than once in 4 to 6 years.

**Porters loam, eroded hilly phase (15–30% slopes) (PA).**—This phase is composed of a fairly large acreage of hilly Porters loam that has been cleared and used for cropland, and, as a result, has become moderately eroded. It has a light-brown friable 3- to 5-inch loam surface soil and a moderate-brown friable clay loam to fine sandy clay loam subsoil. External drainage is rapid, and internal drainage, moderate. The soil has slightly finer textured subsoil than the steep phase and also differs in having a less sloping relief and a profile somewhat deeper to bedrock. It is associated with other Porters soils and with soils of the Habersham series.

Approximately 7 acres of Porters very fine sandy loam, severely eroded hilly phase, a total area too small to map separately, is included with this phase. The included soil differs in texture and in degree of erosion. More than 75 percent of the original surface soil has been lost from the included area.

*Use and management.*—All areas of Porters loam, eroded hilly phase, have been cleared. Approximately 23 percent of it is used for

crops and 45 percent for pasture. About 27 percent is idle. Although better suited to hay and small grains than to other crops, this soil will produce some corn and truck crops under proper management and is very good for permanent pasture. Natural fertility is moderate to good, but the soil is strongly to very strongly acid. It responds well to lime and fertilizer. The soil should be kept in sod crops two-thirds to three-fourths of each rotation period and should be tilled on the contour and strip-cropped to help prevent further erosion.

**Porters stony loam, steep phase (30-60% slopes) (P<sub>H</sub>).—**This phase is on mountain uplands, where it is associated with other Porters soils and with Stony rough land (Porters and Ramsey soil materials). It is the most extensive soil in the county, occupying about 27 percent of the area. The individual bodies are generally large and are widely scattered throughout the county. External drainage is rapid, and internal drainage is moderate. The profile is more shallow and the subsoil is less distinct than in Porters loam, steep phase.

The soil is derived from material weathered from Great Smoky conglomerate, which includes fine-grained sandstone, graywacke, quartzite, schist, and slate. These rocks are resistant to weathering and break down into soil very slowly. Stone on the surface and mixed through the soil would interfere with cultivation, should the soil be cleared.

*Use and management.*—This steep phase is mostly in forest consisting of white, post, chestnut, black, and red oaks, hickory, yellow-poplar, hemlock, and a few shortleaf pines. The undergrowth is mainly mountain-laurel and rhododendron. Because of its steep slopes and stoniness, the soil is very poorly suited to crops or pasture. Most of it probably will be left in forest. The soil is medium to strongly acid, low in calcium, magnesium, and phosphorus, and medium in potash. It is friable, permeable, and has moderate water-holding capacity.

**Porters stony loam, eroded steep phase (30-60% slopes) (P<sub>F</sub>).—**Unlike the steep phase this soil has been cleared, cultivated, and allowed to erode considerably. It is permeable, moderate in water-holding capacity, and moderately fertile. Erosion has removed from 40 to 75 percent of the original surface soil in most places and caused a few small gullies. The present surface soil is a light-brown to brown friable stony loam, 3 to 5 inches thick. Underlying is a moderate-brown friable loam or light clay loam subsoil having a high stone content. Although stones are numerous enough to interfere with cultivation, all areas have at some time been used for crops. External drainage is rapid, and internal drainage is moderate. The total acreage is not large. Associated with this soil are areas of the steep phase of Porters stony loam and of Stony rough land (Porters and Ramsey soil materials).

Included with this soil are about 21 acres of Porters stony loam, severely eroded steep phase, and about 28 acres of Porters stony very fine sandy loam, severely eroded steep phase, neither of which is mapped separately in this county. Both of these soils are more severely eroded than this soil, and Porters stony very fine sandy loam, severely eroded steep phase, has a higher content of very fine sand. Also included are about 5 acres of Porters stony very fine sandy

loam, eroded steep phase, which differs in having a higher content of fine sand. Another inclusion is approximately 11 acres of rough gullied land, which is little more than an intricate pattern of gullies and the small patches of soil between gullies that have no agricultural use unless they undergo a long rebuilding process of reforestation. All areas should be set to pine or other seedlings and mulched, fenced, and otherwise protected from further erosion.

*Use and management.*—About 24 percent of Porters stony loam, eroded steep phase, is in crops, 44 percent is lying idle, and 32 percent is in pasture. The soil is very poorly suited to crops and only fair for pasture. Although it is best used for trees, it will produce some pasture, hay, and even corn and small grain under careful management. Where cultivated crops must be grown, rotations should be long and the soil should be left for considerable time in grass and legumes. Liberal applications of lime and fertilizer will also be necessary to maintain production. A clean-cultivated crop should not appear in the rotation more than once in 5 to 7 years, and contour tillage and strip cropping must be followed to prevent further erosion damage. This phase is medium to strongly acid and is susceptible to further damage by erosion despite its high stone content.

**Porters stony loam, hilly phase (15–30% slopes) (P<sub>g</sub>).**—Distinguishing this soil from the steep phase are much milder slopes, a considerable quantity of stone on the surface and throughout the profile, and, in many places, less rapid external drainage. The 5- to 8-inch surface layer of brown friable loam is underlain by a moderate-brown friable porous clay loam subsoil that continues to depths of 18 to 24 inches before grading into brown and gray partly weathered rock.

The soil is strongly acid (averaging about pH 5.1), very low in calcium, magnesium, and phosphorus, medium in potash, and high in organic matter. It is friable, permeable to roots, water, and air, and good in water-holding capacity. It occurs chiefly on lower slopes and smoother tops of mountains, and is associated with other Porters soils. Somewhat over 300 acres of Porters stony very fine sandy loam, hilly phase, which differs only in being more sandy, are included.

*Use and management.*—The phase is nearly all in forest consisting of white, post, black, red and chestnut oaks, hemlock, yellow-poplar, dogwood, sourwood, maple, and hickory. The undergrowth is of mountain-laurel and rhododendron. Stones would interfere with cultivation should areas be cleared for tilled crops. A few areas on tops of mountains near Hooper Bald are cleared and used for pasture, but the soil is poorly suited to crops and only fair for pasture. Apparently little or no lime or fertilizer has been added to pastured areas, yet the patches of grass between rocks make satisfactory growth and furnish fair grazing from early in May to the middle of September. Some of the more accessible areas could be cleared and used for pasture, should such use become necessary.

**Porters stony loam, eroded hilly phase (15–30% slopes) (P<sub>e</sub>).**—In color and other physical characteristics this soil is very similar to the hilly stony phase. It differs from Porters loam, steep phase, in occupying less steep slopes and having a moderately eroded surface soil, stones on the surface and throughout the profile, and a slightly



more friable subsoil. The relatively small areas are closely associated with other Porters soils.

The surface soil is light-brown friable stony loam, and the subsoil is moderate-brown friable clay loam. In places the soil has been materially injured for crops or pasture because 50 to 75 percent of the original surface soil has been lost through erosion. The subsoil is within plow depth over about a half or more of each area. Ordinary tillage has mixed subsoil material with remnants of the original surface soil and altered the color and texture of the present surface layer. The many gullies are too deep to be filled by ordinary tillage but can be crossed with farm machinery.

Approximately 9 acres of the severely eroded hilly phase of Porters stony loam are included with this phase, as well as about 82 acres of Porters stony very fine sandy loam, eroded phase, which differs only in the texture of its surface soil. These included soils require management similar to that used for this eroded hilly phase.

*Use and management.*—About 23 percent of Porters stony loam, eroded hilly phase, is in crops, 26 percent in idle cropland, and 51 percent in pasture. The soil is best suited to forest, hay, and pasture, but some areas may prove suitable for some small grains and truck crops if and when such crops must be grown.

**Ramsey silt loam, steep phase (30–60% slopes) (Rg).**—This phase is shallow over highly siliceous rocks. It occurs in the mountain uplands and is closely associated with Ramsey shaly silt loam, steep phase, and Stony rough land (Porters and Ramsey soil materials). Both external and internal drainage are rapid. The 3- to 7-inch surface layer, a light brownish-gray friable silt loam, is underlain by a dusky-yellow poorly developed silty clay loam subsoil, which is shallow but friable and permeable. Though there is much shale in the parent material, few if any shale fragments are in the surface soil. The parent material weathered from shale and slate in the Great Smoky conglomerate, which also contains schist, sandstone, graywacke, and quartzite. Practically all of this phase is covered with forest that includes post, red, white, and chestnut oaks, hickory, sourwood, dogwood, maple, sweetgum, locust, yellow pine, hemlock, and yellow-poplar. The undergrowth consists of laurel, rhododendron, holly, huckleberry, and numerous smaller plants.

Profile in a wooded area :

- 0 to 1 inch, light-brown organic loam containing a considerable quantity of partly decomposed leaves and twigs.
- 1 to 9 inches, light brownish-gray friable silt loam; weak crumb structure; moderate supply of organic matter.
- 9 to 17 inches, dusky-yellow silt loam to silty clay loam; friable and permeable; weak coarse crumb structure; a few shale fragments; similar to material of overlying layer in many places.
- 17 inches +, light grayish-brown soil material mixed with weathered shale.

The soil varies somewhat in color and depth. In most places it is a Lithosol, having little or no appreciable change in color, texture, or structure from the first inch or two to the underlying rock. Nevertheless, some moderately well differentiated profile layers do occur in places. The soil is more shallow to bedrock on stronger slopes and ridges than in slightly concave areas, where moisture relations are somewhat better and more soil material has accumulated.

*Use and management.*—Apparently Ramsey silt loam, steep phase, is best suited to forest. Practically none of it has been cleared. Under cultivation its shallow profile erodes quickly and is often seriously damaged. Cleared areas should be kept in well-managed pastures. If an area must be cultivated, it should be returned to a sod crop the next season. The soil is moderately to strongly acid, low in fertility and organic matter, and only moderate in water-holding capacity.

**Ramsey silt loam, eroded steep phase (30–60% slopes) (RE).**—The areas of this phase occur on steep eroded slopes in close association with other Ramsey soils and with Stony rough land (Porters and Ramsey soil materials).

The surface soil is light brownish-gray friable silt loam; the subsoil, a dusky-yellow friable silt loam to light silty clay loam. The soil is acid to very strongly acid, low in organic matter, and relatively low in water-holding capacity. External drainage is rapid to very rapid; internal drainage, rapid. Between 50 and 75 percent of the original surface soil has been removed by erosion, and in places numerous short gullies are present. Most of the gullies are not deep; they can be crossed with ordinary farm machinery but are not obliterated by usual tillage methods.

*Use and management.*—Approximately 16 percent of the soil is used for crops, 32 percent is idle cropland, and 52 percent is in pasture. The principal crops are corn, rye, and grass, but yields are usually low. Where the soil is needed in the farm program, however, fair yields of hay and pasture can be expected under very good management practices. Because tilled areas are very susceptible to erosion, cultivated crops should not be grown more than once in a rotation lasting 5 or 6 years. The soil is very poorly suited to further cultivation and only fair for pasture; it should be planted to trees.

**Ramsey silt loam, hilly phase (15–30% slopes) (Rr).**—In most profile characteristics this inextensive phase is very similar to the steep phase, with which it is associated. It differs in having less sloping relief and, generally, slightly more differentiated subsoil layers. The surface soil is light-brown friable silt loam, 5 to 8 inches thick, and the subsoil to a depth of 10 to 30 inches, moderate-brown friable silt loam to silty clay loam. The average total depth of the soil, however, is not over 20 inches. External drainage is moderate and internal drainage is rapid. The soil is friable and permeable throughout and has moderate water-holding capacity. It is medium to strongly acid (pH 4.8) and has a low content of calcium, magnesium, and phosphorus and a medium content of potash and organic matter.

Approximately 22 acres of the eroded hilly phase were included because the separate areas were too small to map. This included soil differs in that it has been cropped and has as a result lost from 40 to 75 percent of the original surface soil by erosion.

*Use and management.*—Ramsey silt loam, hilly phase, is mostly in forest, to which it seems best suited. Cleared areas are used for corn, small grains, and grasses, but yields are generally low and careful management is required to prevent further damage by erosion.

Because of its shallow profile, susceptibility to erosion, and low natural fertility, the soil is poorly suited to cultivated crops and only

moderately suited to pasture. If this soil must be cropped, it should not be planted to clean-cultivated crops more often than once in 4 or 5 years, and then it should be tilled on the contour and strip cropped to prevent considerable erosion. The soil, however, responds well to applications of lime and fertilizer, and these amendments should be used so as to obtain and maintain a better growth of crops and pasture.

**Ramsey shaly silt loam, steep phase (30–60% slopes) (R<sub>D</sub>).**—This soil is one of the more extensive in the county. It has formed on mountain uplands from material that weathered from highly siliceous rocks, mainly shale. The areas are closely associated with Stony rough land (Porters and Ramsey soil materials). The soil has a weak-brown to pale-brown friable surface soil, 3 to 6 inches thick, and a moderate-brown friable silt loam to light silty clay loam subsoil. It differs from Ramsey silt loam, steep phase, in having a considerable quantity of shale on the surface and throughout the profile and a slightly more friable and more shallow subsoil. It is strongly acid (about pH 4.8), medium in potash, and low in magnesium, calcium, phosphorus, and organic matter. The soil is very permeable to water, roots, and air, but its water-holding capacity is somewhat low.

*Use and management.*—Because of the steep slopes, shallow profile, low fertility, and great susceptibility to erosion, this phase should remain in forest. If cleared, the shaly or slaty surface soil would make cultivation difficult. The native vegetation consists chiefly of white, post, red, black, chestnut, and Spanish oaks, locust, yellow-poplar, hemlock, dogwood, sourwood, mountain-laurel and rhododendron. Tree growth is only moderate, but satisfactory forest yields can be obtained by selective cutting.

**Ramsey shaly silt loam, eroded steep phase (30–60% slopes) (R<sub>B</sub>).**—Making up this phase are areas of the steep phase that have been used for crops or pasture until part of the surface soil has been eroded away. This soil differs from the steep phase principally in having considerably more shale fragments throughout the profile and a more shallow surface soil and subsoil. The subsoil layers also are generally slightly less well defined. The areas occur in association with other Ramsey soils.

The surface soil is light brownish-gray friable shaly silt loam, 2 to 4 inches thick; the subsoil, a dusky-yellow friable shaly silt loam to light silty clay loam. The soil is strongly acid (generally pH 4.8, or lower), low in calcium, magnesium, and phosphorus, and medium in potash and organic matter. It is very permeable to roots, water, and air, but its water-holding capacity is relatively low.

*Use and management.*—About 16 percent of the phase is in crops, 34 percent in cropland left idle, and 50 percent in pasture. It is very poorly suited to crops or pasture, however, and is best used for forest. Where the soil is needed for crops, heavy applications of lime and fertilizer must be applied to obtain reasonable yields. Also, tillage on the contour and strip cropping should be practiced to prevent serious erosion. A clean-cultivated crop should not be planted more often than once in 5 to 7 years.

**Ramsey shaly silt loam, hilly phase (15–30% slopes) (R<sub>C</sub>).**—This phase occurs on mountain uplands in association with other Ramsey soils and Stony rough land (Porters and Ramsey soil materials). It

differs from Ramsey shaly silt loam, steep phase, chiefly in having less sloping relief, slower external drainage, and somewhat better defined profile layers. The surface soil is light-gray or yellowish-gray friable shaly silt loam; the shaly subsoil, a dusky-yellow friable silt loam to light silty clay loam.

The soil is strongly acid (pH less than 5.0), low in calcium, magnesium, and phosphorus, and medium in potash and organic matter. Shale fragments on the surface and in the profile would interfere with tillage if the soil were cleared for crops. External drainage is moderate; internal drainage, rapid. The soil is permeable to water, roots, and air and has moderate water-holding capacity. It probably would respond well to applications of lime and fertilizer. Mainly because of its strong slopes and susceptibility to erosion, however, it should remain in forest.

Included in mapping are approximately 59 acres of Ranger slaty silt loam, hilly phase, which are similar to this soil in most profile characteristics and in management requirements. The included soil has a brownish-gray friable silt loam surface soil and a light olive-gray somewhat porous shaly loam or shaly silt loam subsoil.

**Ramsey shaly silt loam, eroded hilly phase (15-30% slopes) (RA).**—The relatively inextensive areas of this phase are associated with other Ramsey soils and are actually areas of Ramsey shaly silt loam, hilly phase, that have lost between 40 and 75 percent of the original surface soil as a result of erosion following clearing and cultivation. The remaining surface soil is yellowish-gray friable silt loam. The subsoil is dusky-yellow friable silt loam to silty clay loam. The entire profile contains much shaly material.

The phase differs from the steep phase in having less sloping relief, many shale fragments on the surface and throughout the profile, a somewhat more shallow surface soil, and a somewhat lower organic-matter content. Like other Ramsey soils, it is strongly acid, low in calcium, magnesium, and phosphorus, and medium in potash. The soil is permeable to water, roots and air, but its water-holding capacity is somewhat low.

About 3 acres of Ranger slaty silt loam, eroded hilly phase, are included. This included soil formed mainly from weathered slate material and has a relatively dark surface soil and olive-gray subsoil.

*Use and management.*—Approximately 11 percent of Ramsey shaly silt loam, eroded hilly phase, is used for crops, about 40 percent is idle cropland, and about 49 percent is in pasture. Because of strong slopes, high susceptibility to erosion, and generally low fertility, the soil is considered better suited to trees than to crops and pasture. Areas that must be put into cultivation should receive the liberal applications of lime and fertilizer necessary to obtain and maintain satisfactory yields. Strip cropping and tillage on the contour are needed to prevent further damage by erosion. Corn, small grains, and hay are the crops most commonly grown, but yields are usually low. In any event, a row crop should not be grown more often than once in 4 years.

**Ranger slaty silt loam, steep phase (30-60% slopes) (RH).**—Areas on mountain uplands, largely in the northeastern part of the county, are occupied by this soil. It is closely associated with Ram-

sey soils and Stony rough land (Porters and Ramsey soil materials) and has formed from material that weathered from bluish-gray slate. External and internal drainage are rapid.

All areas are supporting forest trees similar to those on the Ramsey and Porters soils—post, white, black, chestnut, and Spanish oaks, hickory, maple, sourwood, dogwood, laurel, yellow pine, white pine, and hemlock. The undergrowth consists of various sprouts and huckleberry, buckberry, and other small plants.

**Profile description:**

- 1 to 6 inches, brownish-gray friable porous slaty silt loam; moderate quantity of well-decomposed organic matter. (Under native forest the surface inch is dark gray.)
- 6 to 16 inches, light-olive or brownish-gray friable silt loam; many slate fragments; coarse crumb structure.
- 16 inches +, soft disintegrated slate fragments mixed with a little soil material; at a depth of less than 25 inches usually underlain by hard slate.

In places bedrock is only a few inches below the surface and outcrops are common. Some variations may be noted in the color of the surface soil and in the degree of subsoil development. Included because of the small size of the individual areas are about 190 acres of Ranger slaty silt loam, eroded steep phase. This included soil differs mainly in that it is moderately eroded and has very rapid external drainage.

*Use and management.*—Although Ranger slaty silt loam, steep phase, is permeable to roots, moisture, and air, it is poorly suited to cultivation because of its steep slopes and high susceptibility to erosion. The surface soil is moderately well supplied with organic matter, but on the whole this phase is somewhat low in fertility and water-holding capacity. Most areas have a moderate tree growth that with selective cutting and encouragement of desirable species can be expected to produce good yields of timber.

**State silt loam, undulating phase (4-7% slopes) (S<sub>A</sub>).**—Although this soil has developed from moderately recent alluvial material, it lies on terraces along some of the larger streams in such position that there is little danger of overflow even during high floods. It is associated with soils of both the bottom lands and the mountain uplands. Slopes range from 1 to 10 percent but are usually 4 to 7 percent. External drainage is very slow to slow, and internal drainage is moderate. The principal areas are in the vicinity of Robbinsville and Milltown, near Stecoah, and along Tulula Creek. Most areas have been cleared, but it is apparent that the native vegetation included ironwood, maple, beech, and ash, some hemlock, hickory, buckeye, and yellow-poplar, and an undergrowth of rhododendron, laurel, briers, and ferns.

**Representative profile in cultivated areas:**

- 0 to 8 inches, light-brown friable silt loam; weak granular structure.
- 8 to 30 inches, moderate yellowish-brown friable clay loam; indistinct nut structure easily crumbled into a friable mass; contains a very few finely divided mica flakes.
- 30 inches +, yellowish-brown friable clay mottled with reddish brown and containing black specks; some fine mica flakes; at a variable depth underlain by sand and gravel beds.

Most of the variations in this soil result because of differences in parent material and because of small areas of other soils present. In-

cluded because of small total extent are areas totaling about 52 acres of State silt loam, nearly level phase, 5 acres of State silt loam, slightly eroded rolling phase, and 38 acres of Warne silt loam, nearly level phase, soils not mapped separately in the county. The included State soils differ primarily in slope or degree of erosion. Warne silt loam has developed on the more level areas on stream terraces and has very slow subsoil drainage. The Warne surface soil consists of brownish-gray friable silt loam, and the subsoil consists of mottled gray and yellow heavy, somewhat plastic clay.

*Use and management.*—About 84 percent of State silt loam, undulating phase, is in crops, 8 percent in cropland left idle, and 8 percent in pasture. The principal crops are corn, soybeans, potatoes, burley tobacco, rye, wheat, and hay, from which very good to excellent yields can be expected under adequate management. The soil is acid and permeable to moisture, roots, and air. It is moderately fertile to very fertile, responds well to applications of lime and fertilizer, and has good water-holding capacity. Because of these factors, the soil may be used intensively. Erosion is not a hazard, but control of runoff by contour tillage and perhaps in some places by terraces is advisable.

**Stony colluvium (Tusquitee soil material) (2–30% slopes) (Sb).**—The relatively small areas of this land type are closely associated with Tusquitee soils at or near the base of slopes or along old stream channels. Accumulations of stone and soil material that have rolled, sloughed, or washed from higher slopes are the source of this land. Except for its high stone content, the profile is somewhat similar to that of Tusquitee silt loam, rolling phase. The soil, which usually occurs in pockets among the stones, has a brown friable surface soil 8 to 15 inches thick. The subsoil, if any, is brownish-yellow or yellowish-brown friable clay or clay loam 5 to 32 inches thick. Stones scattered over the surface and mixed through the soil mass are so numerous they prevent cultivation. There is wide variation from place to place, and, in most areas, little or no profile development. External drainage is slow to moderate, and internal drainage is moderate to rapid.

Of the total area, about 10 acres is on slopes of 2 to 7 percent, about 80 acres on slopes of 7 to 15 percent, and the rest, which includes most of the areas, is on 15- to 30-percent slopes. Practically none of this land type is suited to cultivated crops, but in places it may be used for pasture. The tree growth is moderate to good.

**Stony rough land (Porters and Ramsey soil materials) (30–90% slopes) (Sc).**—This land type, covering far the largest acreage of any soil unit in the county, occupies rough, rugged, or very steep areas in which large boulders and rock outcrops are numerous (see pl. 1, A). It occurs on the steeper mountain slopes, ridges, and peaks in all parts of the county. Many of the areas are comparatively large. Where soil material is present it belongs mainly to the Porters and Ramsey series. The dominant slope range is 40 to 70 percent, though the extreme range is 30 to 90 percent, or possibly more. External drainage is very rapid, and internal drainage is moderate. This land type is associated with Ramsey shaly silt loam, steep phase, Porters stony loam, steep phase, and Ranger slaty silt loam, steep phase.

Included because of limited extent and relative similarity are about 4 acres of Ramsey shaly silt loam, eroded very steep phase, and about



500 acres of Ramsey shaly silt loam, very steep phase, neither of which is mapped separately in this county.

*Use and management.*—Practically all of Stony rough land (Porters and Ramsey soil materials) is covered with forest about the same as that on Porters stony loam, steep phase, and Ramsey shaly silt loam, steep phase. Tree growth varies from place to place, depending on the quantity of soil present. Some stands of excellent timber have greatly deteriorated because of inaccessibility or the excessive cost involved in cutting and hauling. Because of stoniness and very shallow soil, all areas of this land should remain in forest. Management should include selective cutting of timber and other practices to encourage the growth of the more desirable species.

**Toxaway silt loam (0–3% slopes) (TA).**—Young alluvium consisting of materials washed from soils underlain by granite, gneiss, and schist is the parent material for this soil. It is associated with Congaree and Chewacla soils of the first bottoms and State soil of the low terraces, from which it can be readily distinguished by its almost black surface layer. External drainage is slow to very slow, and internal drainage is very slow. In many places the water table is at or near the surface much of the time. Although most areas have been cleared, it is evident that the native vegetation included willow, ironwood, alder, various rushes, and similar growth tolerant of wet conditions.

Representative profile in cleared areas:

- 0 to 9 inches, brownish-black smooth friable silt loam containing a considerable quantity of well-decomposed organic matter.
- 9 to 34 inches, mottled light-brown, brown, and gray silty clay loam; somewhat sticky to slightly plastic.
- 34 inches +, mottled grayish-brown or brownish-yellow and gray clay; contains partly decomposed sedge plants and roots and some finely divided mica flakes.

Variations in this soil are mainly due to differences in distance to water channels and differences in the alluvial parent material.

*Use and management.*—When artificially drained, this soil is permeable to roots, water, and air, yet it has good water-holding capacity. It ranges from very strongly to slightly acid. It is moderately high in calcium and magnesium, low in phosphorus and potash, and high in organic matter. The undrained areas are not suitable for crops and only moderately well suited to pasture. If the soil is adequately drained, hay, corn, beans, and cabbage can be produced satisfactorily. The soil is easily tilled, relatively high in fertility, and responds well to applications of lime and a complete fertilizer. Approximately 25 percent of the total area is now being used for crops, and 75 percent for pasture.

**Tusquitee silt loam, rolling phase (7–15% slopes) (Tc).**—In the vicinity of Hard Slate Gap and east of Pinnacle Knob, areas of this soil have formed at or near the base of slopes from colluvium—material consisting of local wash and creep from higher surrounding areas. External drainage is slow, and internal drainage is moderate. The entire profile is very permeable and good in water-holding capacity. The soil is strongly acid (pH about 4.6), very low in calcium and phosphorus, low in magnesium, medium in potash, and high in organic matter. The native vegetation consists of post, white, black,

and red oaks, hickory, maple, sourwood, yellow pine, a few white pines, laurel, and numerous bushes.

Profile in a cultivated area:

- 0 to 8 inches, light-brown to dark-brown friable silt loam; contains considerable organic matter.
- 8 to 40 inches, brown to dark-brown heavy but friable silt loam to silty clay loam containing many shale fragments; medium nut structure.
- 40 inches +, flat-rounded and angular shale fragments mixed with soil material.

In a few places there is no noticeable difference in the color, texture, or structure of the surface soil and subsoil.

Included with this phase are areas of several soils too small in total acreage to map separately. There is approximately 150 acres of Tusquitee silt loam, slightly eroded rolling phase, that differs in having lost between 25 and 50 percent of the original surface by erosion, and approximately 33 acres of Tusquitee silt loam, eroded rolling phase, which has lost 50 to 75 percent of the original surface soil. Neither of these phases is mapped separately in the county.

*Use and management.*—Because of favorable slope, good tilth, very good moisture relations, and excellent response to treatment, Tusquitee silt loam, rolling phase, is one of the most desirable soils in the county for crops and pasture. Approximately 63 percent of it is used for crops, 9 percent is idle cropland, and 3 percent is in open pasture. The rest is in forest. The soil is well suited to truck crops, burley tobacco, corn, small grains, soybeans, and hay. Good to excellent yields can be expected. The soil is not subject to serious damage by erosion when ordinary care is exercised, and it can be farmed intensively. Contour tillage and use of adequate rotations are advisable to conserve moisture and check soil loss through erosion. A row crop should not be grown for two successive years; it should be alternated with sod-forming crops, preferably legumes.

**Tusquitee silt loam, undulating phase (2–7% slopes) (Td).**—Less susceptibility to erosion and, in places, a somewhat deeper profile are the main points of difference between this soil and the rolling phase of Tusquitee silt loam. It is associated with other Tusquitee soils and those of the Porters and Ramsey series. The brown to dark-brown friable 10- to 18-inch silt loam surface layer is underlain by a moderate-brown heavy but friable silt loam to silty clay loam subsoil. External drainage is very slow to slow, and internal drainage is moderate. The soil is medium to strongly acid and moderate to very good in fertility. It makes excellent response to good management.

*Use and management.*—Approximately 64 percent of this land is used for crops, 9 percent is idle cropland, and 27 percent is in forest. It is very well suited to truck crops, corn, small grains, soybeans, hay, and tobacco; and because of its favorable relief, good fertility, and excellent response to treatment, it can be used intensively. It is permeable to water, roots, and air; has a good water-holding capacity; and can be tilled under a relatively wide range of moisture conditions. Use of proper crop rotations is the chief requirement for conserving this soil.

**Tusquitee silt loam, hilly phase (15–30% slopes) (Tb).**—This phase differs from the rolling phase mainly in having stronger slopes,

a less deep profile, and greater susceptibility to erosion. The surface soil is weak-brown friable silt loam 5 to 7 inches thick; the subsoil, a moderate-brown friable silt loam to light silty clay loam. The soil is strongly to very strongly acid, low in calcium, magnesium, and phosphorus, and medium in potash and organic matter. It is permeable to water, roots, and air and has good water-holding capacity. External and internal drainage are both moderate.

Included because their limited extent would not justify separate mapping are about 46 acres of the slightly eroded hilly phase, and 4 acres of the eroded hilly phase of Tusquitee silt loam. The included soils differ from this soil primarily in degree of erosion.

*Use and management.*—Approximately 22 percent of Tusquitee silt loam, hilly phase, is used for crops, 13 percent for pasture, and 45 percent for forest. The rest is left idle. The soil is fairly well suited to small grains, hay, and pasture but it must be protected from erosion when used for these crops. Row crops should not be planted more often than once in 3 to 4 years, and the land should be tilled on the contour and strip cropped to check erosion. The soil responds well to lime and fertilizer and will produce moderate to good yields if adequately managed.

**Tusquitee stony loam, rolling phase (7–15% slopes) (Tg).**—Areas on colluvial slopes, mostly near small streams and in narrow valleys, are occupied by this soil, which except for its stoniness, slightly coarser texture, and in many places, shallower profile, is very similar to the rolling phase of Tusquitee silt loam. The soil is associated with others of its own series and with Porters and Ramsey soils. Rock fragments up to boulder size are common on the surface and in the profile. The number of stones on the surface and in the profile varies but is everywhere great enough to interfere with cultivation.

The soil is strongly acid, low in calcium, magnesium, phosphorus, and potash, and medium in organic matter. Owing to its friable surface soil and subsoil, this phase is permeable to water, roots, and air. It has good water-holding capacity. External and internal drainage are moderate. The native vegetation consists of white, post, chestnut, red, and black oaks, hickory, hemlock, locust, yellow-poplar, laurel, and rhododendron.

Included with this rolling phase are about 158 acres of the slightly eroded rolling phase, and about 7 acres of Tusquitee stony clay loam, eroded rolling phase, neither of which are mapped separately in this county. These soils, included because of limited extent and similar profile characteristics, differ primarily in degree of erosion. They may have a greater quantity of stone on the surface.

*Use and management.*—About 35 percent of Tusquitee stony loam, rolling phase, is used for crops, 2 percent for pasture, and 60 percent for forest. The rest of the land is left idle. The soil is fair for hay and pasture. Potatoes, tobacco, small grains, and truck crops are grown to some extent. Under good management, which includes use of contour tillage and a sod-forming crop in the rotation at least every other year, the less stony areas can be used intensively without being seriously damaged by erosion. The soil responds well to lime and fertilizer. If these amendments are added, moderate to good

yields can be expected. In places it may be beneficial to remove some of the stones. The stones may be useful for building.

**Tusquitee stony loam, undulating phase (2-7% slopes) (T<sub>U</sub>).—**In color and most other physical characteristics this soil resembles Tusquitee silt loam, rolling phase, fairly closely. Its chief differences are a greater quantity of stone on the surface and throughout the profile, a slightly more friable subsoil, milder relief, and slower external drainage. The quantity of stone on the surface and in the soil varies but is sufficient to interfere materially with cultivation, and in many areas makes hand labor necessary for nearly all operations. Associated with this phase are other Tusquitee soils and Porters and Ramsey soils.

*Use and management.*—About 40 percent of this land is used for crops, 3 percent for pasture, and 40 percent for forest; the remaining 17 percent is left idle. The soil is fairly well suited to small grains, hay, and pasture. The less stony areas can be used for corn, potatoes, and vegetables. Applications of lime, fertilizer, and green manure may be expected to bring excellent response and with proper management very good yields can be obtained. The soil can be cultivated intensively without danger of serious damage from runoff. Removing some of the stones would greatly increase its value for cultivation.

**Tusquitee stony loam, hilly phase (15-30% slopes) (T<sub>H</sub>).—**This phase has a brown friable loam surface soil and a moderate-brown friable silt loam to light silty clay loam subsoil. It differs from Tusquitee silt loam, hilly phase, primarily in having a greater quantity of stone on the surface and throughout the profile, a slightly more friable subsoil, and a shallower profile. The soil is moderately productive, but the many stones make tillage difficult. Only the less stony areas can be used for cultivated crops. The soil is strongly acid, very low in calcium and phosphorus, low in magnesium and potash, and medium in organic-matter content. External drainage is moderate to rapid, and internal drainage is moderate. A few slightly eroded areas are included because they are of limited extent and similar in profile characteristics.

*Use and management.*—About 17 percent of Tusquitee stony loam, hilly phase, is used for crops, 3 percent for pasture, and 77 percent for forest. The remaining 3 percent consists of idle cropland. The crops are mainly corn, small grains, and hay.

Fair to good yields of pasture and hay can be expected if management is good. The soil responds well to lime and fertilizer. Where cultivated, the soil should be tilled on the contour and strip cropped to prevent serious erosion. Removing some of the stones from the less sloping parts would help greatly in areas required for cultivation.

**Tusquitee stony loam, eroded hilly phase (15-30% slopes) (T<sub>E</sub>).—**Areas of the hilly phase now moderately eroded, chiefly by sheet erosion, make up this phase. Approximately 50 to 75 percent of the original surface material is missing, and some subsoil material has been mixed with the remaining original surface soil by tillage. As a result the soil to plow depth is finer textured and somewhat lighter colored than in uneroded areas of hilly Tusquitee stony loam.

The surface soil, or plow layer, consists of light-brown to moderate

brown friable stony loam. The subsoil is moderate-brown friable stony clay loam. The soil is strongly acid, moderately fertile, friable, permeable, and good in water-holding capacity. External drainage is moderate to rapid, and internal drainage is moderate. Stoniness and strong slopes make the soil difficult to cultivate and conserve. The stones, however, help retard surface runoff. The phase occurs in association with other Tusquitee soils.

*Use and management.*—About 17 percent of this eroded hilly phase is used for crops and 35 percent for pasture; about 48 percent is cropland left idle. The soil is fair for pasture and hay. Corn and small grains are grown to some extent.

Where this soil must be cultivated, it should be planted to row crops not more often than once in 4 or 5 years, and strip cropping and tillage on the contour should be practiced to prevent further erosion. The soil responds to applications of lime and fertilizer, and moderate yields can be expected, especially on the less stony areas. Fair to good pasture is obtained, especially where some of the stone has been removed.

**Wehadkee silt loam (0-2% slopes) (WA).**—A small total acreage, mostly in poorly drained first bottoms along streams, is occupied by this soil formed from alluvial material. The profile, mottled from the surface downward, is for the most part friable. The subsoil, however, is slightly plastic and sticky. External and internal drainage are very slow; all areas are subject to overflow from adjacent streams. In places the water table may be only 12 to 18 inches below the surface. The soil is strongly to very strongly acid, medium to high in content of mineral nutrients and organic matter, and good in water-holding capacity. It is associated with Congaree and Chewacla soils. The native vegetation includes maple, willow, alder, birch, and beech, and an undergrowth of water-loving plants.

Profile of the soil under pasture:

- 0 to 8 inches, brownish-gray friable silt loam mottled with dark reddish-brown; contains a few pockets of dark yellowish-brown fine sandy material and a few finely divided mica flakes.
- 8 to 30 inches, mottled gray and brownish-black or yellowish-brown friable silt loam having a massive structure.
- 30 inches +, mottled gray, yellow, and brown silt loam to silty clay loam containing pockets of fine sand and gravel.

In places, especially near the stream channel, sand and gravel beds are at a relatively shallow depth. Also, there are variations in the texture of both the surface and subsoil, primarily because the soil is derived from stratified alluvial material.

*Use and management.*—About 26 percent of this soil is used for pasture, and 48 percent for forest. Approximately 9 percent is cropland left idle, and 17 percent is in crops. Unless it is drained, this soil is not suited to cultivated crops. If not drained, it can be used for some pasture grasses. Good drainage is very difficult to establish because the soil is in low-lying areas, in many places only little above stream level. Drained areas can be made moderately productive and are well suited to corn, cabbage, and snap beans. The soil responds well to lime and fertilizer.

## SOIL USES, MANAGEMENT, AND PRODUCTIVITY

In this section are given the major uses for which Graham County soils are suitable, the important management requirements of these soils, and the average yields these soils can be expected to produce over a period of years under different levels of management. First discussed are the agricultural practices now generally followed in the county. Following this, under the heading Land Classes and Soil Management, the soils are placed in five land classes—First-, Second-, Third-, Fourth-, and Fifth-class soils—according to their relative suitability for agriculture. Within each of these land classes the soils are grouped on the basis of similarity in management requirements. All soils in one of these management groups require relatively similar management, and management practices are suggested for them on that basis. The table of estimated crop yields is explained under the heading Soil Productivity.

### AGRICULTURAL PRACTICES

Most cropland is broken in spring, usually during March and April; some of the more level areas, especially those on the bottom lands, are broken in November and December. Land sown in winter cover crops is plowed just before seeding. On the smoother areas, two-horse turning plows are used for breaking the land. On the sloping, hilly, or steep lands, hillside turning plows are used for breaking. The crops are planted by single-row planters or by hand. Row crops are usually cultivated with one- or two-horse cultivators. The steeper lands, however, require considerable hand labor.

Contour tillage is generally practiced on steep land, but practically none of the land has been terraced. Many of the poorly drained areas have been artificially drained by open ditches or covered box-type ditches made of poles and slabs of rock. Probably not more than 1 percent of the land area needs drainage. Most of this small total area is partially drained, but a more adequate system would bring much improvement.

The farmers do not as a rule follow practices designed to control water on the land. Nevertheless, they usually plant more close-growing crops on the hilly and steep land than on the smoother soils and cultivate the stronger slopes, mostly from necessity, approximately on the contour. Little is done to control insect pests and diseases. The preparation given the seedbed and the way other farming operations are carried out vary considerably between farms, but, in general, the farms on the bottom lands and stream terraces are probably better managed than those on the hilly and steep uplands.

### GENERAL PREFERENCES IN SOIL USE

Most farmers recognize the suitabilities of certain soils for particular crops. Congaree silt loam and Chewacla silt loam are considered best for corn, soybeans, rye, and hay. Hiwassee soils are good for wheat, lespedeza, corn, and clover. Habersham and Porters soils are used mostly for grasses, corn, and small grains; under good management they produce fair yields of clover and lespedeza. Tusquitee



soils are considered excellent for all crops, especially potatoes and corn. Most of the sweetpotatoes are grown on colluvial and bottom-land soils.

#### CROPPING PRACTICES

##### CORN

Much of the corn is harvested by hand. The tops are cut, and the stalks are stripped of leaves, tied in bundles, and stacked in the field. The corn is left on the stalks until thoroughly dried and then is pulled and taken to the barns or piled out for husking.

##### POTATOES

The potato crop is planted in spring, fertilized with 200 to 800 pounds of 6-8-6 or similar fertilizer, and harvested mainly by hand in September. Methods of cultivating and harvesting sweetpotatoes are similar to those used for white potatoes.

##### TOBACCO

Most of the tobacco is grown on Tusquitee, Habersham, and Porters soils. Beds for seeding tobacco are usually prepared late in February or early in March, and the tobacco is transplanted to the field during May. Tobacco generally receives 400 to 1,000 pounds of fertilizer an acre, and yields range as high as 2,300 pounds an acre on the better soils.

##### HAY

The largest yields of hay can be expected from the better soils, especially those that receive lime and fertilizer. The hay is cut for the most part with mowers, but on steep land with a scythe. In large part the hay is stacked in the field and fed on the land. Oats are sometimes seeded and cut for hay and are also used as a nurse crop for legumes.

##### PERMANENT PASTURE

Pastures have not been very important because they have been unfenced and cattle have been permitted to graze anywhere. This open range has now been abandoned, and some permanent pastures are being established. Most of the pasture is on the Porters soils and Chewacla silt loam. The grazing season extends approximately from May 1 to October 15, but the actual season depends on the elevation and on the condition of the pasture, which is fairly often modified by seasonal rainfall. Pasture yields vary considerably, but are generally good, especially under adequate management.

The quality of permanent pasture varies from farm to farm and from field to field, but in general it is good. Much of the variation is caused by treatment with fertilizer and lime, by the natural fertility of the soil type, and by the type of rotation, if any, followed. Applications of  $\frac{1}{2}$  to 1 ton of ground limestone and 200 to 400 pounds of phosphate an acre are often used to improve pasture. The sod can be greatly benefited by reseeding with a mixture that includes

(1) Kentucky bluegrass, redtop, orchard grass, and Korean lespedeza, or (2) Ladino clover and orchard grass or tall fescue. On most land the usual rate of seeding is about 25 pounds of the mixture an acre.

#### CROP ROTATIONS

Crops are rotated on some farms. The usual rotations are made up of corn and hay, and minor crops of small grains, tobacco, and potatoes. In general the rotations can be divided into two groups: (1) Rotations used on uplands and (2) rotations used on bottom lands and colluvial lands.

The rotations on the soils of uplands generally consist of corn or small grain the first year, interplanted with or followed by a legume-grass mixture, or rye, which is used for hay, grazing, or as a green-manure crop. The legume crop or grass is left on the land for 2 to 5 years. Where rye is grown, corn or potatoes are generally planted the following summer. When tobacco is grown, the land is usually seeded to rye after the tobacco has been harvested and then planted to potatoes the following year. Some areas of the uplands are kept continuously in sod crops that are used for grazing or for hay.

On the bottom and colluvial lands the soils are continuously cropped to corn or to corn-rye or corn-clover rotations, although some tobacco may be planted. Rye is usually planted in fall after the tobacco is cut; then potatoes are grown the following summer, rye again, and finally corn. Some of the poorly drained bottom land is used for hay or for grazing.

No definite plan or rotation system is drawn up by farmers for long-time use, but for the most part they try not to plant the same fields to the same crop year after year. In many cornfields soybeans or peas are sown at the last cultivation of the corn. These legumes are turned under as a green-manure crop in the fall when the land is prepared for rye.

#### FERTILIZER AND LIME

The greater part of the fertilizer is factory-mixed and is used for tobacco, potatoes, and corn. Much of the superphosphate and lime supplied by the Tennessee Valley Authority and the Production and Marketing Administration is used for pasture.

Different fertilizer mixtures are used for different crops. Mixtures such as 4-10-6 and 5-10-5 are most commonly used for corn. Superphosphate is used primarily where small-grain crops are fertilized. The manure produced on the farm is generally applied to the tobacco and corn. Potatoes often receive from 200 to 1,600 pounds (or an average of about 800 pounds) of 6-8-6 or 8-8-8 an acre.

There has been a general increase in the use of lime, most of which is applied to meadow and truck crops, especially on bottom lands. Some lime is applied to the more accessible pasture areas, but little is used on the steeper slopes. Use of legumes both for hay and for soil improvement has increased.

#### INTERPRETATION OF AGRICULTURAL PRACTICES

The practices discussed under the headings Crop Rotations and Fertilizer and Lime vary somewhat from farm to farm but are useful in interpreting yields given in columns A of table 11.

### LAND CLASSES AND SOIL MANAGEMENT

The soils of the county have been placed in five groups—First-, Second-, Third-, Fourth-, and Fifth-class soils—on the basis of their relative physical suitability for agricultural use.<sup>4</sup> First-class soils are most desirable for use in the present agriculture; the other classes are progressively less desirable.

The physical suitability of an individual soil for agricultural use is determined chiefly by the characteristics that contribute to its productivity, workability, and conservability. An ideal soil is very productive of a large number of important crops, easily worked, and easily conserved. All soils of this county fall short of the ideal, but they differ widely in degree of shortcoming; for example, a soil may be highly productive and easily conserved, but difficult to work.

By comparing the soil characteristics within and among farms, the soils can be ranked according to their desirability for the agriculture of the area under present conditions. This has been done for Graham County. Livestock raising is an important enterprise on many farms in this county; therefore, the suitability of the soils for pasture has been considered in determining the rank of each soil. When information based on experience with a soil was lacking, it was ranked by comparing it with other soils of similar characteristics for which information was available. The relative suitabilities of the soils for agricultural use, as given in this report, are evaluations based on the experience of farmers, extension workers, experiment station personnel, vocational agricultural teachers, and others.

#### FIRST-CLASS SOILS

First-class soils are very good to excellent for agriculture. They differ somewhat in characteristics but are relatively similar in physical suitability and chemical properties. Each is moderately well supplied with plant nutrients and fairly high in natural productivity, as compared with other soils of the county. Nevertheless, even the most fertile one responds to additions of suitable amendments for some crops. All are well drained; yet they retain moisture fairly well and thereby tend to insure a relatively even and generally adequate supply for crops. Good tilth is easily maintained, and the range of moisture conditions suitable for tillage is comparatively wide. The soils are moderately well supplied with organic matter and permeable to air, moisture, and roots. None has any adverse condition or property such as stoniness or unfavorable relief, and each will withstand intensive use if special management practices are followed. The problem of conserving fertility and soil material is relatively simple.

The First-class soils of this county are listed by management groups in table 3, which also gives the percentage of each soil in crops, cropland left idle, open pasture, and forest in 1944.

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<sup>4</sup>As used in this report land use refers to the broad classes of use as follows: (1) Tilled crops (row crops, small grains, and annual hay), (2) permanent sod crops for either pasture or hay, and (3) forest. Soil management practices include (1) selection and rotation of crops; (2) application of lime, manure, crop residues, and commercial fertilizers and other soil amendments; (3) tillage practices; and (4) engineering measures for control of water on the land.

**TABLE 3.**—*First-class soils of Graham County, N. C., listed by management groups and the estimated percentage of each in crops, cropland left idle, open pasture, and forest*

Management groups and soils	Crops	Idle crop- land	Open pasture	Forest
<b>GROUP 1-A:</b>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
State silt loam, undulating phase.....	84	8	8	0
Tusquitee silt loam:				
Rolling phase.....	63	9	3	25
Undulating phase.....	64	9	0	27
<b>GROUP 1-B:</b>				
Congaree silt loam.....	78	22	0	0

**GROUP 1-A**

The soils of group 1-A occur on stream terraces and colluvial slopes. They are similar in most profile characteristics but differ somewhat in slope. State silt loam, undulating phase, and Tusquitee silt loam, undulating phase, have developed on slopes ranging from 2 to 7 percent, whereas Tusquitee silt loam, rolling phase, has developed on slopes ranging from 7 to 15 percent. Each has slow to very slow external drainage and moderate internal drainage and is fertile, permeable, friable, and practically free of stones.

The crops commonly grown on the soils of the group are tobacco, potatoes, corn, soybeans, and legumes for hay. Because of favorable physical properties, the soils are well suited to intensive row cropping, but contour tillage is advisable to prevent damage by erosion. Crop yields may be increased by additions of organic matter.

*Use and management.*—The fertilizer and lime requirements are very similar, and each soil of this group responds well to treatment. Corn, small grain, and truck crops should receive most of the nitrogen used as a side dressing. Mineral nutrients should be well distributed throughout each rotation period. Manure, when available, is generally more economically used on soils of the uplands, but it would be very beneficial to corn, tobacco, or alfalfa on the soils of this group. Table 8 shows suitable crops, suggested rotations, and water control measures for the soils of this group; and table 9 shows the quantity and analysis of fertilizer needed for the various crops within each rotation and gives the time of application. These recommendations are general, however, and will be modified by the condition of each soil, its previous management, and by other factors.

Potatoes usually should not be grown in the same rotation with alfalfa because alfalfa requires large quantities of lime, which leaves the soil only mildly acid and therefore in a condition in which potato scab thrives. Cabbage, as a rule, should not follow a sod crop because of wireworm hazard. If the nitrogen content of the soil used for growing tobacco is too high, the quality of the crop will be injured.

No special practices are necessary for the management of these soils. Terraces could be used to an advantage on some of the slopes. All of the soils are easily plowed and cultivated and can be worked under

a relatively wide range of moisture conditions with light to moderately heavy implements. The soils are now used intensively, and they produce a large percentage of the grain grown in the county. Rotations are not generally practiced; sometimes one row crop is alternated with another, but frequently the same crop is grown 2 to 5 years in succession. As noted in table 8, some of the suggested rotations are: (1) Corn, lespedeza or soybeans; (2) cabbage or potatoes, small grains, clover; and (3) corn, tobacco, and mixed hay for 2 years. Additional rotations are listed in table 8, and many other satisfactory rotations could be devised. In choosing a rotation, the farmer should keep in mind the needs of the farm and the methods of farm operation as well as the soil. Truck crops, corn, and tobacco normally receive most of the fertilizer. Very little fertilizer is applied to small grains, and as a rule pasture and hay receive relatively light applications of phosphate and potash.

#### GROUP 1-B

Congaree silt loam, the only soil of management group 1-B, is of alluvial origin. It occurs in first bottoms, but in most places is not so close to the streams as Buncombe loamy fine sand of group 3-A. The surface soil and subsoil of Congaree silt loam are friable and open, but they retain sufficient moisture for the production of any of the crops commonly grown in the area. The soil is moderately fertile, responds well to treatment, and is not subject to severe losses of plant nutrients through leaching. Since it occupies favorable positions and is easily tilled and conserved, it may be farmed intensively; and on it, even though the acreage is limited, a large part of the corn, truck, and other row crops may be produced.

*Use and management.*—No special tillage practices are required. The land is generally broken late in winter or early in spring. The soil may be worked relatively soon after a rain with little or no danger of puddling. Light implements may be used, and deep plowing is not necessary.

Corn, small grains, clover, and truck crops are well suited to the soil, but no particular crop rotation is in general use. When the Congaree soil must be used for most of the grain grown on the farm it may be planted to corn each year, but during winter it should be kept in crimson clover or rye, which is turned under in spring in order to maintain the organic-matter content.

Stream channels should be kept open so as to reduce the hazard of floods as much as possible, since external drainage is slow to very slow and internal drainage is medium. Because of flooding, some crop losses may be expected about once in 3 or 4 years. Suitable crops and recommended crop rotations and soil amendments are given in tables 8 and 9.

#### SECOND-CLASS SOILS

Certain soils are rated as Second-class because of their relief, degree of erosion, stoniness or gravelliness of the surface soil, or poor drainage. In general, these soils are good to very good for pasture and fair to good for tilled crops. Within a limited range they differ in productivity, workability, and conservability, each one being moderately deficient in one or more of these three conditions. These

deficiencies are more pronounced than in First-class soils but less pronounced than in Third-class soils; consequently, Second-class soils are less suitable for agriculture than First-class soils but more suitable than Third-class soils.

In table 4 the Second-class soils of the county are arranged by management groups and the estimated percentage of each soil in crops, idle cropland, open pasture, and forest is given for 1944.

TABLE 4.—*Second-class soils of Graham County, N. C., listed by management groups and the estimated percentage of each in crops, cropland left idle, open pasture, and forest*

Management groups and soils	Crops	Idle cropland	Open pasture	Forest
<b>GROUP 2-A:</b>				
Tusquitee stony loam:	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Rolling phase.....	35	3	2	60
Undulating phase.....	40	17	3	40
<b>GROUP 2-B:</b>				
Chewacla silt loam.....	55	10	4	31
Toxaway silt loam.....	25	0	75	0
<b>GROUP 2-C:</b>				
Hiwassee silty clay loam, eroded rolling phase.....	85	12	3	0

#### GROUP 2-A

The rolling and undulating phases of Tusquitee stony loam are the only soils in management group 2-A. They have developed on colluvial slopes ranging from 2 to 15 percent and are similar in most profile characteristics and management requirements. They are both fertile and occupy favorable relief, but have stones on the surface and throughout the profile that interfere with cultivation. External drainage is slow to very slow, and internal drainage is moderate. Each soil is friable and permeable and has good water-holding capacity. The less stony areas could be cleared and used successfully for crops.

*Use and management.*—These soils are well suited to corn, small grains, hay, and pasture. Rotations are not generally practiced. Often the same row crops will be grown year after year, but most farmers alternate crops to some extent. Contour tillage and strip cropping are advised to prevent damage by erosion, and, where practical, at least some of the stones should be removed.

Table 8 gives suitable crops, suggested rotations, and water control for the soils of this group, and table 9 gives estimated fertilizer requirements for each crop used within the rotation and suggested dates of application.

The only special tillage practices necessary are those required to prevent the large quantities of stones from damaging implements. The soils can be plowed early in spring or late in fall with ordinary farm implements. They can be cropped intensively in suitable rotations, but care should be exercised to maintain fertility and the



organic-matter content. The following rotations prove very satisfactory: (1) Small grain followed by lespedeza for 2 years; (2) tobacco followed by orchard grass for 3 years; and (3) continuous hay or continuous pasture.

Fertilizer requirements vary with the rotation as well as with the condition of the soil. In general, nitrogen should be applied to the corn and small grains, and mineral fertilizers to all crops. The soils respond well to applications of lime and fertilizer and produce good to very good yields. Manure is very beneficial, especially to corn and tobacco, and the plowing under of green manure greatly adds to the productivity of the soils.

#### GROUP 2-B

Management group 2-B is made up of Chewacla silt loam and Toxaway silt loam, two imperfectly to poorly drained soils of the first bottoms that are subject to flooding during periods of high water. Each soil has developed on slopes ranging from 0 to 3 percent. The Chewacla soil has very slow external drainage and slow internal drainage; the Toxaway, slow to very slow external drainage, and very slow internal drainage. The Chewacla soil is more extensive than the Toxaway. Most areas of both soils are small and somewhat scattered throughout the county; nevertheless, they are important to individual farms because of their relatively high fertility, ease of cultivation, and ease of conservation. Both soils are friable, permeable, and good in water-holding capacity, but if they are not adequately drained, crops may be damaged or destroyed in wet years.

*Use and management.*—No special tillage practices are necessary, but reasonable effort should be made to avoid tilling these soils when they are too wet or too dry. Light to moderately heavy farm implements and farm animals are sufficient. The land is usually broken late in winter or early in spring. Many cultivated areas are drained by open ditches, but where fields have a sufficiently low water table, tile drains probably would be more satisfactory. As a general practice, little or no fertilizer is used except for corn and truck crops. Wooded areas that are not too wet could be cleared and used for crops.

Chewacla and Toxaway soils are well suited to corn, small grains, hay, and pasture. When carefully managed, they are suitable for truck crops. Rotations that are very satisfactory are: (1) Corn, lespedeza or soybeans; (2) corn, a crimson-clover intercrop, and then potatoes or cabbage; or (3) continuous hay or continuous pasture.

The soils of group 2-B are moderately fertile to very fertile, medium to strongly acid, and permeable to both water and air. Where drainage is satisfactory, good to excellent results can be expected from applications of lime and fertilizer. Table 8 gives suitable crops, suggested rotations, and water-control measures for the soils of this group, and table 9, suggested fertilizer requirements for each crop within each rotation and dates of application. The soils should be tested regularly for lime and fertilizer content in order that they may be used most efficiently. In places, especially where legume hay is being produced, they are deficient in potash. Some losses from flooding may be expected every second or third year.

## GROUP 2-C

Only one soil, Hiwassee silty clay loam, eroded rolling phase, is in management group 2-C. This soil, very limited in extent, has developed on high terraces from old alluvium. Slopes range from 4 to 15 percent. External drainage is moderate to rapid; internal drainage, moderate to slow. The soil is friable, permeable, and good in water-holding capacity.

*Use and management.*—Corn, small grain, clover, and tobacco are suited to this soil. The general practice is to apply 600 to 800 pounds of 3-9-6<sup>5</sup> fertilizer an acre for tobacco and 200 to 300 pounds of 4-10-6 or 5-10-10<sup>6</sup> for corn. Small grains, especially when they follow corn in the rotation, are seldom fertilized.

Suitable crops, rotations, and water-control practices are suggested for this soil in table 8; estimated fertilizer requirements for each crop used within the rotation and suggested dates of application are furnished in table 9. Contour tillage and strip cropping are advised to prevent damage by erosion, and where terraces can be constructed feasibly, they would be beneficial. Tillage must be carried on within a relatively narrow range of moisture, but otherwise no special tillage practices are required. The soil is moderately fertile and responds well to lime and fertilizer. Good to excellent crop yields can be expected under adequate management.

## THIRD-CLASS SOILS

The Third-class soils are of questionable value for crops requiring tillage. Under normal conditions and under good management practices, they may be productive. In general, they are well suited to grasses and hay and should be kept in a sod-forming crop one-half to two-thirds of each rotation period. Among the limitations or undesirable features of these soils are strong slopes; low mineral plant nutrient or organic matter content; unfavorable texture, structure, or consistence; eroded condition; and low water-holding capacity.

In table 5 the Third-class soils are listed by management groups, and the estimated percentage of each soil in crops, idle cropland, open pasture, and forest is given for 1944.

## GROUP 3-A

Buncombe loamy fine sand, the only soil in management group 3-A, has developed on first bottoms next to streams. Slopes range from 0 to 3 percent. External drainage is very slow, and internal drainage is rapid. Because of its coarse texture, the soil is very permeable to water and somewhat droughty. The organic-matter content is low, and the fertility is moderate to low.

*Use and management.*—The crops most commonly grown are corn, rye, peas, and mixed grasses. Rotations are not generally followed,

<sup>5</sup> Percentages, respectively, of nitrogen, phosphoric acid, and potash.

<sup>6</sup> In 1952 the established grades recommended for and more commonly used on crops in Graham County were as follows: Corn, 5-10-5, 5-10-10, 6-6-12, 2-12-12, and 6-8-6; small grains, 4-10-6 and 3-12-6; hay and pasture, 0-14-7 and 0-14-14; alfalfa, 2-12-12 and 0-9-27; top-dressing, 14-0-14, 0-10-20, and 8-0-24; tobacco 2-10-8 and 3-9-6; and general, 3-9-9 and 4-8-10.

but most farmers alternate crops. Corn usually receives 200 to 300 pounds an acre of 4-10-6 or 5-10-10 fertilizer, and rye and mixed hay, 100 to 200 pounds of superphosphate. Yields are often somewhat low.

TABLE 5.—*Third-class soils of Graham County, N. C., listed by management groups and the estimated percentage of each in crops, cropland left idle, open pasture, and forest*

Management groups and soils	Crops	Idle crop- land	Open pasture	Forest
GROUP 3-A:	Percent	Percent	Percent	Percent
Buncombe loamy fine sand.....	24	29	35	12
GROUP 3-B:				
Hiwassee silty clay loam, eroded hilly phase.....	21	63	16	0
Porters loam, hilly phase.....	0	0	0	100
Tusquitee silt loam, hilly phase.....	22	20	13	45

Buncombe loamy fine sand is only fair for corn, clover, soybeans, and similar crops. The soil responds well to green manure and to other manure, lime, and fertilizer. Well-suited rotations are (1) corn, with a crimson clover intercrop; (2) cabbage or potatoes, small grains, and clover; and (3) corn followed by lespedeza or soybeans. Table 8 gives suitable crops and suggested crop rotations and methods for controlling water; table 9 indicates fertilizer requirements for each crop within the various rotations and gives suggested dates for planting and for applying fertilizer. It will be noted that somewhat heavier applications of nitrogen fertilizer are suggested for this soil, but even so, nitrogen fertilizer should be supplemented with green manure and other manure.

No special tillage practices are required. The soil can be plowed late in fall or early in spring and requires only light to medium farm implements. It can be worked within a relatively wide range of moisture, and good tilth is easily maintained. Some loss of crops through flooding may be expected every third or fourth year.

#### GROUP 3-B

Of the three soils of management group 3-B, Porters loam, hilly phase, is the most extensive. Tusquitee silt loam, hilly phase, has developed on colluvial slopes; Hiwassee silty clay loam, eroded hilly phase, on high stream terraces; and Porters loam, hilly phase, on mountain uplands. The soils differ somewhat in texture of the surface soil and in degree of erosion, but are similar in most other profile characteristics and in relief. All are moderate to low in fertility and medium in organic-matter content, friable and permeable, and good in capacity for holding water.

*Use and management.*—The most commonly grown crops are corn, crimson clover, tobacco, potatoes, and mixed grasses. The corn and hay receive the larger part of the fertilizer used, and the cornland,

a large part of the manure. Crop yields are somewhat low. When poorly managed the soils are subject to considerable erosion.

If these soils are to be used efficiently it is essential that a good cover to be kept on them and that at least moderate fertility be maintained. Table 8 gives suitable crops and suggested rotations, and table 9 indicates fertilizer requirements for the individual crops within each rotation and suggests dates for planting and applying fertilizer. Small grains, hay, and pasture are better suited than other crops, but with careful management potatoes, truck crops, and tobacco can be grown. Soils of this group need to be kept in sod-forming crops one-half to two-thirds of each rotation period, and contour tillage and strip cropping are needed to prevent erosion. The range of moisture suitable for tillage operations is relatively narrow for the Hiwassee soil but is wide for the Tusquee soil. Porters loam, hilly phase, probably should remain in forest—but if areas of it must be cleared for hay and pasture, they will give good yields under adequate management.

#### FOURTH-CLASS SOILS

Because of their unfavorable characteristics, Fourth-class soils are poorly suited to crops that require tillage but at least moderately productive of pasture. All soils of this group except Wehadkee silt loam have developed on steep slopes and are characterized by considerable stone on the surface and throughout the profile or by poor drainage. As a result they are difficult to cultivate or conserve, or both. They are moderately fertile, however, and hold moisture adequate to maintain a moderately good to very good cover of pasture plants.

These soils are not well suited to cultivation, but a considerable acreage of them is being used for crops because many farms have little or no acreage of soils more suitable. Where they must be used for crops, Fourth-class soils require particularly careful management. On individual farms where adequate areas of fair to good croplands (First-class and Second-class soils) are available, most of the Fourth-class soils are used for pasture or are left in forest.

In table 6 the Fourth-class soils are listed by management groups and the estimated percentage of each soil in crops, idle cropland, open pasture, and forest is given for 1944.

#### GROUP 4-A

The four soils of management group 4-A have been cleared and cultivated at some time, but at present a large part of each soil is in idle cropland or is being used for pasture. The soils have rapid to very rapid external drainage and moderate internal drainage and are moderately or severely eroded. They are friable, permeable, and retentive of moisture, but low in fertility and organic matter.

*Use and management.*—The crops most commonly grown are corn, small grains, lespedeza, clover, potatoes, and mixed grasses. Very little lime or fertilizer is applied to these soils because many of the fields are difficult to reach with sufficient quantities. Crop yields, therefore, are usually somewhat low. Crops are sometimes rotated to prevent excessive erosion, and in many places row crops are planted on the contour. Little or no strip cropping is practiced.

Table 8 gives suggested rotations and suitable crops for the soils of this group. Fertilizer requirements for each crop within a rotation and suggestions for maintaining the fertility of these soils are listed in table 9. The use of lime and complete fertilizers is essential if good yields are to be maintained. Because of steep slopes and susceptibility to erosion, the soils must be tilled on the contour and strip-cropped. They should be planted in row crops only one-fourth to one-third of each rotation period. The land should be plowed early in spring, and the crops planted as soon thereafter as possible. Small grains, hay, and pasture are best suited to these soils, but under careful management corn, tobacco, potatoes, and some truck crops can be successfully grown. Satisfactory rotations are (1) small grains, mixed hay 2 years, and pasture 2 years; (2) small grains; followed by lespedeza for 3 years; and (3) tobacco, followed by orchard grass for 3 years.

TABLE 6.—*Fourth-class soils of Graham County, N. C., listed by management groups and the estimated percentage of each in crops, cropland left idle, open pasture, and forest*

Management groups and soils	Crop	Idle crop- land	Open pasture	Forest
<b>GROUP 4-A:</b>				
Habersham loam:	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Eroded hilly phase.....	40	23	37	0
Severely eroded hilly phase.....	2	75	23	0
Porters loam:				
Eroded steep phase.....	24	41	35	0
Eroded hilly phase.....	23	27	45	5
<b>GROUP 4-B:</b>				
Habersham loam, hilly phase.....	0	0	0	100
Porters loam, steep phase.....	0	0	0	100
Ramsey silt loam, hilly phase.....	18	0	0	82
<b>GROUP 4-C:</b>				
Porters stony loam, hilly phase.....	0	0	0	100
Tusquitee stony loam, hilly phase.....	17	3	3	77
<b>GROUP 4-D:</b>				
Porters stony loam, eroded hilly phase..	23	26	51	0
Tusquitee stony loam, eroded hilly phase.....	17	48	35	0
<b>GROUP 4-E:</b>				
Stony colluvium (Tusquitee soil mate- rial).....	0	5	40	55
Wehadkee silt loam.....	17	9	26	48

Habersham loam, severely eroded hilly phase, should receive careful management to prevent further damage by erosion and to build up its fertility. Each soil of the group responds well to applications of lime and fertilizer, and with adequate management moderate to good yields can be expected.

#### GROUP 4-B

Of the three soils included in management group 4-B, Porters loam, steep phase, is by far the most extensive. Although it occurs

on steeper slopes, it is similar in many profile characteristics to **Habersham loam, hilly phase**. Ramsey silt loam, hilly phase, has finer texture and is somewhat more shallow to bedrock than the other soils. All three soils have excessive or somewhat excessive drainage. They are friable, permeable, and retain moisture well, but are low in fertility and organic matter.

*Use and management.*—Only a very small acreage of the soils in this group has been cleared and used for cultivated crops, and because of their steep slopes and susceptibility to erosion, nearly all areas should remain in forest. If farmers find it necessary to bring areas of these soils into cultivation, they will find the suggestions given under management group 4-A applicable. In cleared areas careful management is required to prevent damage by erosion.

#### GROUP 4-C

The two soils of management group 4-C differ in mode of occurrence but have similar profile characteristics. Porters stony loam, hilly phase, occurs on mountains, whereas Tusquitee stony loam, hilly phase, occupies colluvial slopes. Slopes range from 15 to 30 percent. External drainage is moderate to rapid, and internal drainage is moderate. Sufficient stone is on the surface and in the profile to interfere with any tillage operations. These soils are friable and permeable and have good water-holding capacity, but they are somewhat low in organic-matter content and only moderately fertile.

*Use and management.*—All of Porters stony loam, hilly phase, is in forest. Only 23 percent of Tusquitee stony loam, hilly phase, is cleared, and that is used mostly for crops. Tobacco, potatoes, corn, and mixed grasses are the crops most commonly grown. Corn and tobacco receive most of the fertilizer but produce relatively low yields.

Because of their strong slopes, stoniness, and susceptibility to erosion, the soils of this group are better suited to forest than to crops or pasture. Where economic conditions make clearing necessary, the soils should be planted in sod-forming crops two-thirds to three-fourths of each rotation period and fields should be strip-cropped and tilled on the contour to prevent erosion. Management for areas that must be cultivated is similar to that suggested for soils in management group 4-A.

#### GROUP 4-D

The two soils of management group 4-D, Porters stony loam, eroded hilly phase, and Tusquitee stony loam, eroded hilly phase, have a total area of 403 acres. Slopes range from 15 to 30 percent. External drainage is moderate to rapid, and internal drainage is moderate. The soils have lost over half the original surface soil by erosion. The Tusquitee soil has somewhat finer texture than the Porters and must be tilled within a slightly narrower moisture range. Each soil is friable and permeable and has good water-holding capacity, but is somewhat low in organic matter and only moderately fertile. The rock fragments on and in the soils interfere somewhat with tillage.

*Use and management.*—All areas of these soils have been cleared and cultivated at some time, and at present approximately 20 percent of their acreage is being used for crops and 40 percent for pasture. Corn, clover, timothy, small grains, lespedeza, and potatoes are the



most common crops, but yields are often low. Corn usually receives from 200 to 300 pounds an acre of 4-10-6 or 5-10-10 fertilizer, and potatoes, from 300 to 500 pounds of 6-8-6. The other crops are seldom fertilized.

Because of steep slopes, stoniness, and erosion damage the soils of this group are best suited to forest, hay, and pasture. Areas used for cultivated crops require the same management as that suggested for soils in management group 4-A. Care must be exercised to control water and reduce erosion. For these purposes sod-forming crops grown for two-thirds to three-fourths of each rotation period should prove helpful. The soils respond fairly well to treatment, and with adequate management give moderate to good yields.

#### GROUP 4-E

The two soils in management group 4-E are Stony colluvium (Tusquitee soil material) and Wehadkee silt loam. Stony colluvium occurs on slopes ranging from 2 to 30 percent and has slow to moderate external drainage and moderate to rapid internal drainage. Wehadkee silt loam, an alluvial soil of the first bottoms that formed on slopes ranging from 0 to 2 percent, has very slow external and internal drainage.

*Use and management.*—Stony colluvium (Tusquitee soil material) is a land type rather than a soil type. Stoniness makes it unsuited to tilled crops, but it is used in many places for hay and pasture. The Wehadkee soil is friable, permeable, and fertile and has good water-holding capacity. Unless it is adequately drained, however, it is not suited to tilled crops and only fairly well suited to hay and pasture.

The soils of this group respond well to applications of lime and fertilizer and produce good pasture. When drained, the Wehadkee soil can be used for corn, potatoes, some truck crops, hay, and pasture. Table 8 gives suggested rotations and suitable crops for these soils; table 9 suggests fertilizer treatments, by crop, for each rotation, as well as dates for applying the fertilizer.

#### FIFTH-CLASS SOILS

Fifth-class soils are poorly suited to cultivated crops or pasture under almost any condition. They are steep, stony, shallow, poor in moisture relation, and low in fertility. On some farms lack of better land may force use of some of these soils for pasture or cultivated crops, but conservation and workability are very difficult to manage and yields are generally low. Hand implements must be used in most places for preparing seedbeds and cultivating. These soils are apparently better suited to forest than to crops or pasture.

All the Fifth-class soils have been put into management group 5. Certain soils are discussed in relation to possible uses in the event they must be cropped. Estimated percentages of each soil used for crops or composing idle cropland, open pasture, and forest in 1944 are given in table 7.

#### GROUP 5

Fifth-class soils are not suited to crops requiring tillage, and very poorly to poorly suited to hay crops and pasture. It is therefore as-

sumed that most of their acreage will remain in forest for a long time. Little can be said about soil management for forest production, particularly from a farmer's viewpoint. Selective cutting should be practiced, and the growth of more desirable types of trees encouraged. In harvesting forest products care should be taken to prevent overcutting the timber, seriously damaging the undergrowth, or leaving skidways unprotected. Otherwise, the vegetation remaining may not be enough to prevent loss of soil through erosion.

TABLE 7.—*Fifth-class soils of Graham County, N. C. (management group 5), and the estimated percentage of each in crops, cropland left idle, open pasture, and forest*

Management group and soils	Crop	Idle cropland	Open pasture	Forest
<b>GROUP 5:</b>				
<b>Habersham loam:</b>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Eroded steep phase.....	0	27	73	0
Steep phase.....	0	0	0	100
<b>Porters stony loam:</b>				
Eroded steep phase.....	24	44	32	0
Steep phase.....	0	0	0	100
<b>Ramsey shaly silt loam:</b>				
Eroded hilly phase.....	11	40	49	0
Eroded steep phase.....	16	34	50	0
Hilly phase.....	0	0	0	100
Steep phase.....	0	0	0	100
<b>Ramsey silt loam:</b>				
Eroded steep phase.....	16	32	52	0
Steep phase.....	0	0	0	100
<b>Ranger slaty silt loam, steep phase</b>	1	0	6	93
<b>Stony rough land (Porters and Ramsey soil materials).....</b>	0	0	0	100

*Use and management.*—Nearly all of the soils in management group 5 that are eroded or seriously eroded are those that have been cleared and used for pasture and crops. Only small percentages of some of these eroded soils were cropped in 1944. The eroded soils should be reforested. If it is necessary to use them for pasture or crops, special management practices are required. Soil tests are essential to determine the quantities of lime and fertilizer needed to maintain the fertility that will produce a good grass cover. If it possibly can be helped, a clean-cultivated crop should not be used more often than 1 year out of 5 or 6. Areas that must be cultivated should be managed as soils in management group 4-A, except that they should be planted in longer rotations so that sod-forming crops will be on the land a longer period in the rotation. Grain and truck crops require most of the nitrogen fertilizer applied. The mineral fertilizer will be best used if it is distributed uniformly throughout the rotation period.

At present corn, small grains, truck crops, and hay crops are grown on these soils, but acreages are small and yields are low. It is essential that the more eroded areas be protected against further erosion loss by planting them to trees.

**CROPS, ROTATIONS, AND FERTILIZER REQUIREMENTS**

Suitable crops, crop rotations, and water-control practices are listed in table 8 for the soils of Graham County. Fertilizer requirements, planting dates, and time for applying fertilizer are recommended in table 9, which is keyed to table 8 by management-group numbers (1-A, 2-B, and so on) and by rotation numbers (1, 2, 3, and so on). The information presented is based on current recommendations growing out of experimental work conducted by the Agronomy Department of the North Carolina Agricultural Experiment Station. Necessarily, these recommendations will change as more information becomes available, new methods of applying fertilizer are developed, and better grades of fertilizer are produced.

The recommendations in tables 8 and 9 are offered as guides to the farmer, not as procedures to be rigidly followed. For example, the fertilizer requirement of a given rotation will depend on what nutrients the particular crops will need and to what extent the soil can supply them. Difference in degree of erosion and previous treatment affect the fertilizer needs of a soil. Because of such variations, soil tests should be made when there is doubt as to what kinds and quantities of amendments a soil needs to produce the crops in a selected rotation. Soil tests are especially important in determining lime requirements.

In planning fertilizer applications within a rotation, the farmer should keep in mind the yield levels he expects to maintain, as well as the treatment given the preceding crop. For example, lighter applications of fertilizer may be required for small grains if they follow a heavily fertilized crop of corn or vegetables. The use of phosphorus and potash with lime has been found very beneficial to pasture and hay crops, but if nitrogen is used other plants may crowd out the legumes in the pasture mixture or at least retard their growth. Smaller applications of nitrogen may be used when manure or a good growth from a sod crop has been turned under. The quality of some crops may be injured by excessive applications of some amendments. Potatoes may be harmed by too much lime; the quality of tobacco may be injured by applying too much nitrogen.

The following principles should be kept in mind in applying plant nutrients to crop rotations:

1. *Lime*.—Tests made by the North Carolina Agricultural Experiment Station show that lime is essential if fertilizers are to be efficiently used by plants. Legume crops are usually most responsive to lime, which should be applied either just before seeding the legume or to the crop just preceding the legume in the rotation. Lime is not a substitute for nitrogen, potash, or phosphorus but is essential to plant growth and neutralizes soil acidity.

2. *Nitrogen*.—Corn, small grains, and truck crops give the best returns from direct applications of nitrogen. Legumes in a hay or pasture sod are often retarded or crowded out by other plants when nitrogen is applied.

3. *Phosphoric acid*.—This plant nutrient is essential for the production of seeds and plays an important part in the establishment of young seedlings; consequently, it should be applied to legumes, truck crops, and grains.

4. *Potash*.—Most crops benefit from potash but its part in plant nutrition is not fully known. Applications of potash fertilizer should be well distributed throughout the rotation period. Potash is usually most needed in low-lying areas or on poorly drained soils that are high in organic matter.

TABLE 8.—*Suitable crops and suggested rotations by management groups for soils of Graham County, N. C.*

Management group and soil	Suitable crops <sup>1</sup>	Suggested rotations <sup>1</sup>	Water control	Remarks
GROUP 1-A: State silt loam, undulating phase. Tusquitee silt loam: Rolling phase. Undulating phase.	Corn, small grain, soybeans, hay, and tobacco.	2. Corn, lespedeza or soybeans. 4. Cabbage or potatoes, small grain, red clover. 5. Corn, small grain, lespedeza (2 years). 6. Corn, small grain, alfalfa (4 years). 8. Corn, tobacco, mixed hay (2 years). 10. Peas or snap beans, corn, small grain, lespedeza (2 years).	Contour tillage.	{ Most of the uncleared areas could be cleared and used for crop production.
GROUP 1-B: Congaree silt loam.	Corn, small grain, clover, and truck.	1. Corn, crimson clover. 4. Cabbage or potatoes, small grain, red clover. 5. Corn, small grain, lespedeza (2 years). 10. Peas or snap beans, corn, small grain, lespedeza (2 years).	None.	{ Can be cultivated intensively if fertility level is maintained.
GROUP 2-A: Tusquitee stony loam: Rolling phase. Undulating phase.	Small grain, hay, and pasture.	6. Corn, small grain, alfalfa (4 years). 9. Tobacco, orchard grass (3 years). 12. Small grain, lespedeza (3 years). 14. Continuous hay. 15. Continuous pasture.	Contour tillage.	{ Soils similar to those of group 1-A, but stoniness interferes with cultivation and makes production of corn and tobacco difficult.
GROUP 2-B: Chewacla silt loam. Toxaway silt loam.	Corn, small grain, hay, and pasture.	2. Corn, lespedeza or soybeans. 3. Corn (crimson clover), potatoes or cabbage. 5. Corn, small grain, lespedeza (2 years). 14. Continuous hay. 15. Continuous pasture.	Surface and sub-soil drainage.	{ Soils usually fertile and easy to cultivate if not too wet. Both soils, especially the Toxaway, need drainage.
GROUP 2-C: Hiwassee silty clay loam, eroded rolling phase.	Corn, small grain, clover, tobacco, and alfalfa.	5. Corn, small grain, lespedeza (2 years). 6. Corn, small grain, alfalfa (4 years). 8. Corn, tobacco, mixed hay (2 years).	Contour tillage and strip cropping.	{ Tillage operations must be carried on within a relatively narrow moisture range.
GROUP 3-A: Buncombe loamy fine sand.	Corn, clover, and soybeans.	1. Corn, crimson clover. 2. Corn, lespedeza or soybeans. 4. Cabbage or potatoes, small grain, red clover.	Use of organic matter to increase water-holding capacity.	{ Additions of organic matter very helpful; soil somewhat droughty.
GROUP 3-B: Hiwassee silty clay loam, eroded hilly phase. Porters loam, hilly phase. Tusquitee silt loam, hilly phase.	Forest, small grain, hay, and pasture.	7. Corn or snap beans, mixed hay (2 years), pasture (2 years). 9. Tobacco, orchard grass (3 years). 12. Small grain, lespedeza (3 years). 14. Continuous hay. 15. Continuous pasture.	Contour tillage and strip cropping.	{ Areas should not be cleared, but if cleared should be kept under a good cover to prevent erosion.
GROUP 4-A: Habersham loam: Eroded hilly phase. Severely eroded hilly phase. Porters loam. Eroded steep phase. Eroded hilly phase.	do.	When necessary to cultivate: 7. Corn or snap beans, mixed hay (3 years), pasture (2 years). 9. Tobacco, orchard grass (3 years). 11. Cabbage or potatoes, mixed hay (2 years), pasture (2 years). 12. Small grain, lespedeza (3 years). 13. Small grain, mixed hay (2 years), pasture (2 years). 14. Continuous hay. 15. Continuous pasture.	do.	{ Most of the soil areas have been cleared and cultivated. Owing to the eroded condition of some areas, care must be taken to prevent further damage.

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<b>GROUP 4-B:</b> Habersham loam, hilly phase..... Porters loam, steep phase..... Ramsey silt loam, hilly phase.....		} do.....	(If necessary to bring into cultivation follow suggested rotations for group 4-A).	} do.....	{ Areas should not be cleared, but if they must be cleared should be given careful management to prevent damage by erosion.
<b>GROUP 4-C:</b> Porters stony loam, hilly phase..... Tusquitee stony loam, hilly phase.....					
<b>GROUP 4-D:</b> Porters stony loam, eroded hilly phase..... Tusquitee stony loam, eroded hilly phase.....					
<b>GROUP 4-E:</b> Stony colluvium (Tusquitee soil material). Wehadkee silt loam.....		} do.....	{ 3. Corn (crimson clover), potatoes or cabbage..... 14. Continuous hay..... 15. Continuous pasture.....	{ Surface and sub-soil drainage needed for Wehadkee silt loam. Drainage usually difficult.	{ Stony colluvium suited only to forest or pasture. Some corn and truck crops may be produced on the Wehadkee soil if properly drained.
<b>GROUP 5:</b> Habersham loam: Eroded steep phase..... Steep phase..... Porters stony loam: Eroded steep phase..... Steep phase..... Ramsey shaly silt loam: Eroded hilly phase..... Eroded steep phase..... Hilly phase..... Steep phase..... Ramsey silt loam: Eroded steep phase..... Steep phase..... Ranger slaty silt loam, steep phase..... Stony rough land (Porters and Ramsey soil materials).					
} Forest.....					

<sup>1</sup> Crops best suited to the soil group under prevailing agricultural conditions. Other crops may be suited but usually require special cultural or management practices.

<sup>2</sup> Choice of rotations should be based on the farm program and best land usage. Many

other rotations may be satisfactory. Number preceding suggested rotation refers to rotation order in table 9.

TABLE 9.—*Fertilizer requirements by crop rotations and dates for planting crops and applying fertilizer in Graham County, N. C.<sup>1</sup>*

Rotation and crop <sup>1 2</sup>	Planting date	Date of fertilizer application	Fertilizer requirements <sup>4</sup>			Remarks
			Nitro- gen <sup>5</sup> (N)	Phos- phoric acid (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	
			Lb. per acre	Lb. per acre	Lb. per acre	{Larger fertilizer appli- cations, especially of nitrogen and potash, may increase yields. Additional organic matter and nitrogen benefit soils of group 3-A.
ROTATION 1 (use with man- agement groups 1-B and 3-A):						
Corn.....	May 1-June 1.....	{ At planting.....	20	40	60	
Crimson clover.....	Last corn cultivation.....	{ 6 to 8 weeks after planting.....	40	0	0	{Heavier applications of potash may be neces- sary, especially on the darker soils.
ROTATION 2 (use with man- agement groups 1-A, 2- B, and 3-A):						
Corn.....	May 1-June 1.....	{ At planting.....	20	40	60	
Lespedeza.....	Apr. 15-May 1.....	{ 6 to 8 weeks after planting.....	40	0	0	{Suitable only if soil is drained. Corn and cabbage respond well to lime; potato scab is often increased by excessive liming.
Or soybeans.....	May 1-June 1.....	{ At seeding.....	0	20	20	
		{ At planting.....	0	20	20	
ROTATION 3 (use with man- agement groups 2-B and 4-E):						{Suitable only if soil is drained. Corn and cabbage respond well to lime; potato scab is often increased by excessive liming.
Corn.....	May 1-June 1.....	{ At planting.....	20	40	80	
Crimson clover.....	Last corn cultivation.....	{ 6 to 8 weeks after planting.....	60	0	0	
Potatoes.....	Mar. 20-Apr. 20.....	{ At planting.....	0	0	0	
Or cabbage.....	Feb. 15-May 1.....	{ At planting.....	60	80	100	
		{ 3 weeks after planting.....	30	0	0	

<b>ROTATION 4</b> (use with management groups 1-A, 1-B, and 3-A):						
Cabbage.....	Mar. 15-May 1.....	{ At planting.....	60	80	100	} Clover should be continued 1 or 2 years longer on soils having steeper slopes or on eroded soils.
Or potatoes.....	Mar. 20-Apr. 20.....	{ 3 weeks after planting.....	40	0	0	
Small grain.....	Sept. 20-Oct. 20.....	At planting.....	60	80	100	
Red clover.....	Mar. 1-Apr. 15.....	Mar. 15-Apr. 1.....	30	0	0	
		At seeding.....	0	40	40	
<b>ROTATION 5</b> (use with management groups 1-A, 1-B, 2-B, and 2-C):						
Corn.....	May 1-June 1.....	{ At planting.....	20	80	60	} The quantity of fertilizer may have to be increased.
Small grain.....	Sept. 20-Oct. 10.....	{ 6 to 8 weeks after planting.....	40	0	0	
Lespedeza.....	Mar. 15-Apr. 15.....	Mar. 15-Apr. 15.....	30	50	50	
Do.....			0	0	0	
			0	0	0	
<b>ROTATION 6</b> (use with management groups 2-A and 2-C):						
Corn.....	May 1-June 1.....	{ At planting.....	20	40	80	} Cut small grain early for hay and prepare land for alfalfa seeding. Add additional fertilizer ( $P_2O_5$ and $K_2O$ ) if yields are somewhat low. An alfalfa fertilizer or agricultural borax should be applied to alfalfa at seeding (20 to 30 lb. per acre) and as needed to maintain stand. Apply lime as indicated by soil test.
Small grain.....	Sept. 20-Oct. 10.....	{ 6 to 8 weeks later.....	40	0	0	
Alfalfa.....	Aug. 1-Sept. 1.....	Mar. 15-Apr. 1.....	30	0	0	
Do.....		At seeding.....	20	120	120	
Do.....		Apr. 1-Apr. 15.....	0	0	75	
Do.....		do.....	0	60	60	
Do.....		do.....	0	0	0	

See footnotes at end of table.



TABLE 9.—Fertilizer requirements by crop rotations and dates for planting crops and applying fertilizer in Graham County, N. C.<sup>1</sup>—Continued

Rotation and crop <sup>2 3</sup>	Planting date	Date of fertilizer application	Fertilizer requirements <sup>4</sup>			Remarks
			Nitrogen <sup>5</sup> (N)	Phosphoric acid (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	
			Lb. per acre	Lb. per acre	Lb. per acre	
ROTATION 7 (use with management groups 3-B and 4-A):						
Corn.....	May 1-June 1.....	{ At planting.....	20	40	40	As in rotation 4, hay and pasture should be continued for 1 or 2 years longer on soils having steeper slopes or on soils that are eroded.
		{ 6 to 8 weeks after planting.....	60	0	0	
Or snap beans.....	Apr. 1-June 15.....	{ At planting.....	20	60	60	
		{ At flowering stage.....	30	0	0	
Mixed hay.....	Mar. 15-Apr. 15.....		0	0	0	
Do.....		Mar. 15-Apr. 15.....	0	50	50	
Pasture.....			0	0	0	
Do.....		Mar. 15-Apr. 15.....	0	50	50	
ROTATION 8 (use with management groups 1-A and 2-C):						
Corn.....	May 1-June 1.....	{ At planting.....	20	40	60	Following high yields increase quantities of P <sub>2</sub> O <sub>5</sub> and K <sub>2</sub> O in rotations.
		{ 6 to 8 weeks later.....	60	0	0	
Tobacco.....	May 15-May 30.....	May 1-May 15.....	30	80	80	
Mixed hay.....	Mar. 15-Apr. 15.....		0	0	0	
Do.....		Mar. 15-Apr. 15.....	0	20	20	
ROTATION 9 (use with management groups 2-A, 3-B, and 4-A):						
Tobacco.....	May 15-May 30.....	May 1-May 15.....	40	80	80	Tobacco quality is often improved when crop follows orchard grass or bluegrass sod that is at least 3 years old.
Orchard grass.....	Aug. 15-Sept. 15.....		0	0	0	
Do.....		Mar. 15-Apr. 15.....	0	50	50	
Do.....			0	0	0	

<b>ROTATION 10 (use with management groups 1-A and 1-B):</b>						Rotation suitable also for soils of groups 2-A and 2-C. Following high hay yields soils may need increased fertilizer applications.
Peas.....	Apr. 15-June 15.....	At planting.....	40	50	40	
Or snap beans.....	Apr. 1-June 15.....	{ At planting.....	20	60	60	
		{ At flowering time.....	30	0	0	
Corn.....	May 1-June 1.....	{ At planting.....	20	40	40	
		{ 6 to 8 weeks after planting.....	40	0	0	
Small grain.....	Sept. 20-Oct. 10.....	Mar. 15-Apr. 1.....	30	50	50	
Lespedeza.....	Mar. 15-Apr. 15.....		0	0	0	
Do.....			0	0	0	
<b>ROTATION 11 (use with management groups 4-A, 4-B, 4-C, and 4-D):</b>						On more eroded areas pasture and hay should be continued 1 or 2 years longer and additional fertilizer applied.
Cabbage.....	Mar. 15-May 1.....	{ At planting.....	60	80	100	
		{ 3 weeks after planting.....	40	0	0	
Or potatoes.....	Mar. 20-Apr. 20.....	At planting.....	60	80	100	
Mixed hay.....	Mar. 15-Apr. 15.....		0	0	0	
Do.....			0	0	0	
Pasture.....		Mar. 15-Apr. 15.....	0	60	60	
Do.....			0	0	0	
<b>ROTATION 12 (use with management groups 2-A, 3-B, and 4-A):</b>						Corn may be substituted for small grains when necessary, but land should be kept in hay a longer period afterward.
Small grain.....	Sept. 20-Oct. 10.....	{ At seeding.....	15	50	50	
		{ Mar. 15-Apr. 1.....	30	0	0	
Lespedeza.....	Mar. 15-Apr. 1.....		0	0	0	
Do.....		Mar. 15-Apr. 15.....	0	60	40	
Do.....			0	0	0	
Do.....			0	0	0	

See footnotes at end of table.

TABLE 9.—*Fertilizer requirements by crop rotations and dates for planting crops and applying fertilizer in Graham County, N. C.*<sup>1</sup>—Continued

Rotation and crop <sup>2 3</sup>	Planting date	Date of fertilizer application	Fertilizer requirements <sup>4</sup>			Remarks
			Nitrogen <sup>5</sup> (N)	Phosphoric acid (P <sub>2</sub> O <sub>5</sub> )	Potash (K <sub>2</sub> O)	
			<i>Lb. per acre</i>	<i>Lb. per acre</i>	<i>Lb. per acre</i>	
ROTATION 13 (use with management groups 4-A, 4-B, 4-C, and 4-D):						
Small grain.....	Sept. 20-Oct. 10.....	{ At seeding.....	15	60	60	{ On eroded areas hay and pasture should be maintained a longer period and additional fertilizer added.
Mixed hay.....	Mar. 15-Apr. 15.....	{ Mar. 15-Apr. 15.....	30	0	0	
Do.....		Mar. 15-Apr. 15.....	0	0	0	
Pasture.....			0	60	40	
Do.....			0	0	0	
ROTATION 14 (use with management groups 2-A, 2-B, 3-B, 4-A, 4-B, 4-C, 4-D and 4-E):						
Continuous hay.....	Aug. 1-Sept. 1.....	{ At seeding.....	0	40	20	{ When seeding or re-seeding sow in small grain, corn, or other clean-cultivated crop. Clover stand best maintained by use of lime.
		{ Mar. 15-Apr. 15 in alternate years to maintain stand.	0	60	40	

ROTATION 15 (use with management groups 2-A, 2-B, 3-B, 4-A, 4-B, 4-C, 4-D, and 4-E):

Continuous pasture-----

Aug. 1-Sept. 1-----

{ At seeding-----  
Mar. 15-Apr. 15 in alternate years to maintain stand.

0  
0

60  
60

30  
20

} Same as for rotation 14.

<sup>1</sup> Based on experimental results obtained and recommendations made by the Agronomy Department, North Carolina Agricultural Experiment Station; recommendations subject to change as more information becomes available.

<sup>2</sup> Rotation numbers correspond with those given in table 8.

<sup>3</sup> Management groups are comprised of soils having similar management requirements. Other rotations may be adapted to these management groups.

<sup>4</sup> Each soil should be tested for lime requirements; application of fertilizer and lime should be made to suit crops and in accordance with rotation followed.

<sup>5</sup> Manure should be applied first to thin or galled spots, especially on upland soils. When applied uniformly to a field it gives the best results on tobacco, corn, and alfalfa. The use of each ton of manure cuts the fertilizer requirements per acre as follows: Nitrogen, 12 pounds; phosphoric acid, 6 pounds; and potash, 12 pounds.

The principles just listed are applied in table 10 for a rotation of corn, oats, lespedeza, lespedeza on soils of management group 1-A and to a rotation of tobacco followed by 3 years of orchard grass on soils of management group 2-A. Fertilization of these rotations might be achieved in other ways. For example, straight phosphate and potash might have been applied instead of the complete fertilizers listed, and their use taken into account in applying a complete fertilizer to the rest of the rotation.

TABLE 10.—*Fertilizer recommendations for two crop rotations for Graham County, N. C., 1949*

MANAGEMENT GROUP 1-A

Rotation	Fertilizer		Nitro- gen	Phos- phoric acid	Potash
	Pounds	Mixture	Pounds	Pounds	Pounds
Corn.....	800	2-10-8	16	80	64
Oats.....	275	1 16-0-0	44	0	0
Lespedeza.....	187	16-0-0	30	0	0
Do.....	360	0-14-14	0	50	50
Do.....			0	0	0

MANAGEMENT GROUP 2-A

Tobacco.....	1,000	4-8-10	40	80	100
Orchard grass.....			0	0	0
Do.....	360	0-14-14	0	50	50
Do.....			0	0	0

<sup>1</sup> Additional fertilizer to be added during growing season of corn.

### SOIL PRODUCTIVITY

Average acre yields of principal crops to be expected on each soil of Graham County are given in table 11 for two levels of management. In columns A of this table are listed probable yields under ordinary management; in columns B, probable yields under better management. The yield predictions are based on information obtained from individual farmers throughout the county, the county agricultural agent, and other agricultural leaders. Specific crop yields for periods of several years were obtained where possible. Data on the carrying capacity of pastures were obtained for each soil commonly used for grazing by averaging information given by farmers.

The practices of ordinary management—those commonly followed by most farmers in the county—have been outlined under the heading Agricultural Practices. There are very few farmers in the county who do not make some effort to improve their land by adding manure or small quantities of commercial fertilizer, or by occasionally rotating crops. Evidence of this effort is the steady increase in use of commercial fertilizer and the expanded acreage of legumes.

TABLE 11.—Average acre yields of principal crops to be expected over a period of years under two levels of management and the pasture-carrying capacity, conservability, workability, and physical land class of each soil in Graham County, N. C.

[In columns A, yields to be expected under prevailing, or common, management practices; in columns B, expected yields under better management practices. Blank spaces indicate crop is not generally grown and soil is considered poorly suited to it under the management specified]

Soil	Map symbol	Corn		Rye		Clover and grass hay		Lespedeza hay		Potatoes		Tobacco		Permanent pasture		Workability <sup>1</sup>	Conservability <sup>2</sup>	Land class <sup>3</sup>
		A	B	A	B	A	B	A	B	A	B	A	B	A	B			
Buncombe loamy fine sand <sup>4</sup> .....	BA	Bu. 15	Bu. 35	Bu. 8	Bu. 12	Tons 0.5	Tons 0.8	Tons 0.5	Tons 0.8	Bu. 70	Bu. 120	Lb. -----	Lb. -----	Cow-acre-days <sup>4</sup> 15	Cow-acre-days <sup>4</sup> 40	Very good.....	Fair.....	Third.
Chewacla silt loam <sup>4</sup> .....	CA	30	65	6	18	1.8	2.3	1.3	1.9	75	150	-----	-----	65	125	Good.....	Excellent.....	Second.
Congaree silt loam <sup>4</sup> .....	CB	45	75	12	20	1.3	2.0	1.2	1.8	140	210	1,600	1,900	96	125	Excellent.....	Very good.....	First.
Habersham loam:																		
Eroded hilly phase.....	HA	15	30	7	11	.6	1.1	.6	1.0	65	120	800	1,050	35	75	Fair.....	Poor.....	Fourth.
Eroded steep phase.....	HB	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	25	50	Very poor.....	Very poor.....	Fifth.
Hilly phase.....	HC	18	32	8	12	.7	1.2	.6	1.0	70	125	900	1,100	40	80	Fair.....	Fair.....	Fourth.
Severely eroded hilly phase.....	HD	10	25	6	9	.4	.8	.3	.7	-----	-----	-----	-----	20	45	do.....	Poor.....	Do.
Steep phase.....	HE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	60	Very poor.....	Very poor.....	Fifth.
Hilwassee silty clay loam:																		
Eroded hilly phase.....	HF	18	40	7	16	.8	1.3	.6	1.2	-----	-----	-----	-----	45	85	Fair.....	Poor.....	Third.
Eroded rolling phase.....	HG	25	50	10	18	1.0	1.6	.7	1.4	115	175	1,200	1,700	55	100	Good.....	Good.....	Second.
Porters loam:																		
Eroded hilly phase.....	PA	18	38	8	13	.7	1.1	.5	1.0	65	115	800	1,100	35	80	Poor.....	Poor.....	Fourth.
Eroded steep phase.....	PB	12	26	-----	-----	-----	-----	.4	.8	-----	-----	-----	-----	25	60	Very poor.....	Very poor.....	Do.
Hilly phase.....	PC	20	40	9	13	.8	1.2	.6	1.1	70	130	1,000	1,200	40	85	Poor.....	Poor.....	Third.
Steep phase.....	PD	14	28	-----	-----	-----	-----	.4	.8	-----	-----	-----	-----	30	70	Very poor.....	Very poor.....	Fourth.
Porters stony loam:																		
Eroded hilly phase.....	PE	14	30	7	12	.6	1.0	.5	1.0	55	100	700	950	30	70	Fair.....	Fair.....	Do.
Eroded steep phase.....	PF	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	25	45	Very poor.....	Very poor.....	Fifth.
Hilly phase.....	PG	15	30	8	13	.7	1.1	.5	1.0	60	105	750	1,000	30	70	Fair.....	Poor.....	Fourth.
Steep phase.....	PH	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	30	60	Very poor.....	Very poor.....	Fifth.
Ramsey shaly silt loam:																		
Eroded hilly phase.....	RA	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20	45	Poor.....	Poor.....	Do.
Eroded steep phase.....	RB	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	15	35	Very poor.....	Very poor.....	Do.
Hilly phase.....	RC	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	25	50	Poor.....	Poor.....	Do.
Steep phase.....	RD	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20	40	Very poor.....	Very poor.....	Do.
Ramsey silt loam:																		
Eroded steep phase.....	RE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20	45	do.....	do.....	Do.
Hilly phase.....	RF	15	30	7	10	.6	.9	.4	.6	-----	-----	-----	-----	30	55	Poor.....	Poor.....	Fourth.
Steep phase.....	RG	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	25	50	Very poor.....	Very poor.....	Fifth.
Ranger slaty silt loam, steep phase.....	RE	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	do.....	do.....	Do.

See footnotes at end of table.

TABLE 11.—Average acre yields of principal crops to be expected over a period of years under two levels of management and the pasture-carrying capacity, conservability, workability, and physical land class of each soil in Graham County, N. C.—Continued

Soil	Map symbol	Corn		Rye		Clover and grass hay		Lespedeza hay		Potatoes		Tobacco		Permanent pasture		Workability <sup>1</sup>	Conservability <sup>2</sup>	Land class <sup>3</sup>
		A	B	A	B	A	B	A	B	A	B	A	B	A	B			
State silt loam, undulating phase	SA	Bu. 40	Bu. 75	Bu. 12	Bu. 20	Tons 1.3	Tons 2.0	Tons 1.2	Tons 1.8	Bu. 140	Bu. 220	Lb. 1,600	Lb. 2,000	Cow-acre-days <sup>4</sup> 90	Cow-acre-days <sup>4</sup> 120	Excellent.....	Excellent.....	First.
Stony colluvium (Tusquitee soil material)	SB	15	25											30	45	Very poor.....	Fair.....	Fourth.
Stony rough land (Porters and Ramsey soil materials)	SC															do.....	Very poor.....	Fifth.
Torway silt loam <sup>5</sup>	TA	20	75		12		2.2	.6	1.9		220			40	120	Fair.....	Very good.....	Second.
Tusquitee silt loam:																		
Hilly phase	TB	25	45	9	15	1.0	1.6	.7	1.3	105	170	1,200	1,500	55	100	Poor.....	Poor.....	Third.
Rolling phase	TC	30	60	11	18	1.2	1.9	1.0	1.6	110	200	1,400	1,800	70	110	Very good.....	Very good.....	First.
Undulating phase	TD	35	85	12	20	1.3	2.0	1.1	1.7	120	210	1,500	1,900	85	120	do.....	do.....	Do.
Tusquitee stony loam:																		
Eroded hilly phase	TE	18	38	7	14	.7	1.2	.5	1.1	60	110			40	80	Poor.....	Poor.....	Fourth.
Hilly phase	TF	20	40	8	14	.8	1.3	.6	1.2	70	120			50	90	do.....	do.....	Do.
Rolling phase	TG	25	45	9	16	1.1	1.6	.7	1.4	105	170	1,200	1,500	60	100	Good.....	Good.....	Second.
Undulating	TH	30	60	11	18	1.2	1.9	1.0	1.6	110	200	1,400	1,800	70	110	do.....	do.....	Do.
Wehadkee silt loam <sup>6</sup>	WA		50		12		2.0	.5	1.7					30	110	Poor.....	Very good.....	Fourth.

<sup>1</sup> Workability refers to ease of tillage, harvesting, and other field operations.<sup>2</sup> Conservability refers to the ease with which productivity and workability can be maintained and is based on the ease with which soil material and plant nutrients can be conserved and good tilth maintained.<sup>3</sup> Land classes express relative suitability of soils for general agriculture; for further information see text, p. 35.<sup>4</sup> Cow-acre-days, used to express the carrying capacity of pasture land, is the product

of the number of animal units carried per acre multiplied by the number of days during the year that animals can be grazed without injury to the pasture.

<sup>5</sup> Although high water causes damage to crops every third to fifth year, it is not taken into consideration in these predictions of yield.<sup>6</sup> Yields in columns A are those to be expected without the benefit of artificial drainage; yields in columns B are those to be expected in adequately drained areas.<sup>7</sup> Workability is good to very good when soil is adequately drained.

The practices of better management are those followed by some of the more progressive farmers and by the North Carolina Agricultural Experiment Station in conducting experiments for determining methods of maintaining or increasing soil productivity within practical limits. The management practices used in the experiments were selection of suitable crops and rotations; correct use of commercial fertilizers, lime, and manure; return of organic matter to the soil; and use of proper tillage and engineering measures for the control of water on the land where necessary.

The yields given in columns B may be considered as production goals attainable by feasible practices of good management. Additions of larger quantities of well-balanced fertilizer should produce even larger yields than these. The same goal probably can be reached by several different combinations of management practices. The best choice depends on the farm business as a whole. On one farm it may be practicable to manage the soil so that yields exceed the goal; on another it may not be practical to reach that goal. The best practical management for a farm unit may give yields above the goal for one crop and soil and yields below the goal for another crop on that same soil. By comparing the yields listed in columns B of table 11 with those listed in columns A, one may gain some idea of the response that can be expected from good management.

In interpreting yield estimates in terms of management practices, it should be remembered that different crops require different treatments on the same soil and that past treatments must be considered. Because of these differences, soil tests are essential in planning soil management. Also, there is a point where increases in yields will no longer pay for the intensified management necessary to produce them. The level of management selected may depend on the investment the farmer wishes to make in improving his soils and yields, as well as on other soils, crops, and enterprises on the farm.

## MORPHOLOGY, GENESIS, AND CLASSIFICATION OF SOILS

Soil is the product of the forces of weathering and soil development acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief or lay of the land; and (5) the length of time the forces of development have acted on the parent material.

Climate and vegetation change the parent material from an inert heterogeneous mass to a body having more or less definite genetic morphology. Their action on the parent material is affected to varying degrees by the relief, which determines to some extent the runoff, movement of water through the soil, natural erosion, and the natural vegetation. The character of the parent material also aids climate and vegetation in soil formation and is important in determining internal soil conditions and the kinds of natural vegetation. Other factors affecting the development of the soil into a body in equilibrium with its environment are time and the rate at which the forces of



climate and vegetation act; these forces, in turn, are regulated by the relief and parent material.

## FACTORS OF SOIL FORMATION

### PARENT MATERIALS

The parent materials of the soils of Graham County consist of two classes, based on the source of the material—residual material, derived from the decomposition of rocks in place, and transported material, which has been removed from its original position and deposited on valley uplands and near or along streams. Residual material consists of weathered products from the underlying rocks. Transported material consists of rock fragments and other rock waste moved by gravity and water from the uplands and deposited at the base of slopes, and of alluvial material derived from the uplands and deposited along streams by running water. The material of the first class is related directly to the underlying rocks whence it came, and that of the second class to the soils or rocks from which it was removed.

The rocks giving rise to the residual material are metamorphic and sedimentary. They differ somewhat in chemical and mineralogical composition, and the parent materials derived from them differ likewise. Although sufficient study of the rocks has not been made to compare differences in their chemical and mineralogical composition with differences in the resultant soils, it probably is a fact that differences in most soil developed from the residuum of rocks in place may be attributed to differences in the mineral composition of the rocks. Where the same kind of rock underlies different kinds of soil, the differences in the soils are due to other causes, among them, climate and relief.

Although some soil characteristics can be correlated with the kinds of parent material, others, especially those of regional significance to soil genesis, correlate more closely with other factors.

### CLIMATE

Climate in the lower altitudes<sup>7</sup> differs from that on the mountains; it is characterized by moderately long and warm summers, short and relatively mild winters, and moderately high rainfall. As mild to warm weather prevails during much of the year and the soil is moist most of the time, chemical reactions are rapid. The high rainfall has caused the leaching of soluble materials, as bases, from the soil and also the removal of less soluble materials and colloidal matter downward. The soil is frozen for only short periods and to shallow depths, with the result that the weathering and the translocation of insoluble materials within the soil are intensified.

The temperature in the mountains is considerably lower both in winter and summer than that of the valleys. This difference probably retards chemical reactions. The rainfall in the mountains, on the other hand, is as high or higher, so soluble materials are leached from the soil and less soluble materials and colloidal matter are translocated

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<sup>7</sup> Includes lower mountain slopes, colluvial slopes, stream terraces, and bottoms.

downward. Nevertheless, because the soil is frozen for longer periods and to a greater depth than in the valleys, leaching is somewhat less active.

In general, climate in the valleys is such that Red Podzolic soils develop, whereas climate in the mountains gives rise to Gray-Brown Podzolic soils and Lithosols. All gradations between soils of these great soil groups, however, may be found.

Within any one climatic zone certain outstanding characteristics are common to the well-drained, well-developed soils, but the soils differ in other characteristics because of the effect of factors other than climate. The character of the parent material seems to have been an outstanding cause in bringing about the differences. A large part of the county has a climate that is marginal between the characteristic climate of the Red and Yellow Podzolic region and the climate of the Gray-Brown Podzolic region; consequently, Red Podzolic and Gray-Brown Podzolic soils are closely associated, and differences caused by parent materials, drainage, and age are important in determining the great soil group in which many of the soils belong.

#### PLANT AND ANIMAL LIFE

Higher plants, micro-organisms, earthworms, and other forms of life live on the soil and in it and contribute to its morphology. The nature of the changes that they bring about, depends among other things on the kinds of life and the life processes peculiar to each. The kinds of plants and animals are determined by climate and many other factors of the environment. Climate is the most apparent, but not the most important, determinant of the kinds of plants and animals that grow on the well-developed, well-drained soils, and in this indirect way it influences greatly the morphology of soils. Hence, climate and living organisms together constitute the active factors of soil genesis.

The soils of the county have developed mainly under a growth of Appalachian hardwoods, but some trees of the hardwood-pine type are on southern slopes. The principal hardwood species are chestnut and Northern red oaks, basswood, and yellow-poplar. White pine, hemlock, balsam fir, black birch, black cherry, sugar and red maples, buckeye, beech, scarlet, black and white oaks, cucumbertree (magnolia), sourwood, blackgum, ash, and dogwood grow in smaller numbers. In the hardwood-pine type, shortleaf and pitch pines and scarlet and black oaks predominate. Other trees are Southern red oak, Virginia pine, and post and white oaks. The pure pine stands are on lands formerly cultivated and consist of white and shortleaf pines. In many areas an undergrowth of rhododendron, mountain-laurel, azalea, fern, and galax is common.

Many of the trees of the present-day forest are moderately deep feeders on plant nutrients and shed their leaves annually. Although the content of plant nutrients in the leaves ranges considerably, the quantity of bases and phosphorus returned to the soil is generally high compared with the quantity returned by the leaves of conifers.

Essential plant nutrients are thus restored to the upper part of the soil from the lower part, and the organic material that accumulates

in the soil impedes soil depletion by slowing down the action of percolating water. It is probable that this retardation is more effective on the smoother than on the steeper landscapes and that it tends to counterbalance somewhat the effects of the rapid rock weathering and soil leaching.

Much organic matter accumulates in the upper part of the soil from the decay of plants. This material is acted on by micro-organisms, earthworms, and other life, and chemical reactions result. The organic material decomposes more slowly in the higher altitudes than in the valleys and as a result some soils on the higher mountains accumulate more organic matter than comparable soils in the valleys.

The decomposition of the organic material releases organic acids, which promote the solution of soluble constituents and also the leaching and translocation of inorganic materials. The intensity of the results, however, is conditioned by the effect of climate on the kinds of vegetation and micro-organisms and the rates of reactions and leaching.

#### RELIEF

The relief of Graham County, which ranges from nearly level in first bottoms to very steep in the mountainous districts, modifies the effects of climate and vegetation. On some steep slopes the volume of runoff water is great; hence geologic erosion is rapid and keeps an almost even pace with rock weathering and soil formation. As material for soil formation is constantly being removed from these steep places by water or is being mixed by local slides, enough of it hardly ever remains in place a sufficient time for a profile of genetically related horizons to be formed. Only small quantities of water percolate through the soil, and leaching and translocation of insoluble materials downward in the soil are correspondingly insignificant. The stands of vegetation are generally thinner than on soils having better moisture relationships. In many places soil on a concave slope has a more nearly complete profile development than that on a convex slope. Geologic erosion is apparently slower on the concave than the convex slope, and the moisture relations are more conducive to the growth of dense stands of vegetation.

#### TIME

Soils in the county range from very young to old, but over a very large part of the area they are very young to young. Soil material that has been in place for a short time has been altered very little by climate and vegetation, and therefore a well-defined soil profile of genetically related horizons has not formed. Most of the soils on the first bottoms along streams are of such character. Soil material on steep slopes is replenished by rock weathering as the soil cover is removed by geologic erosion, and here very little opportunity is afforded for the formation of the genetic soil profile. These two broad classes of soil comprise the young or very young soils. Soil material that has been in place for a long time under favorable conditions of relief and other factors of soil genesis develops into soil that in time reaches approximate equilibrium with its environment and can be considered mature or old.

## CLASSIFICATION OF SOILS

Soils are classified on various bases. Some classifications are based on the interrelationships of the soils: some on their need of lime; and some on ease of tillage or on their productivity. This section is concerned with the classification of the soils on the basis of natural characteristics in order that they may be more easily differentiated and managed.

The simplest unit of classification is the soil phase. The phase has the narrowest range of all observable characteristics, both external and internal, but is the unit about which the greatest number and most precise statements can be made.

A soil type has a wider range in characteristics, and fewer and less specific statements can be made about it than about the soil phases that constitute the type, unless there is only one soil phase in the type.

Soil types having layers or horizons that are similar in color, thickness, and arrangement but differ in texture and associated characteristics, as consistence, are grouped into series. In general, differences in texture among soil types of the same series are in many places reflected to some degree in all layers, but the types are defined in terms of the texture of the surface layer. Fewer and less specific statements can be made about the soil series as a whole than about any of its types, unless there is only one soil type in the series.

In soil taxonomy the normal soil profile serves as a basis for comparing soils. In Graham County the normal profile is characterized by a fairly light-colored and medium-textured surface layer, or A horizon; a uniformly colored and relatively fine-textured subsoil, or B horizon; and a lighter colored and, in general, coarser textured parent-material layer, or C horizon.

Normal soil profiles have developed in only a small part of the county and are largely confined to valley uplands and stream terraces. The soils on mountain uplands are predominantly immature, or azonal; their profiles are relatively shallow to bedrock and do not show such sharp differentiation between the layers as the normal profile of soils on valley uplands and stream terraces.

Soil series may be grouped in higher categories. Members of the highest category are called soil orders. In Graham County there are two soil orders, namely, zonal and azonal.

Zonal soils have well-developed soil characteristics that reflect the influence of the active factors of soil genesis—climate and living organisms, chiefly vegetation (10).<sup>a</sup> In Graham County the zonal soils are members of the Red and Yellow Podzolic and Gray-Brown Podzolic great soil groups (5). Azonal soils do not have well-defined profile characteristics because of their youth, or conditions of parent material, or relief, which prevent the development of normal soil-profile characteristics.

The soil series of the county are classified according to soil orders and great soil groups, and the parent rock is given for each in table 12. The great soil groups of the county are (1) Red and Yellow Podzolic soils, (2) Gray-Brown Podzolic soils, (3) Lithosols, and (4) Alluvial soils. This classification is still incomplete, however, and is subject to revision as knowledge about the soil series and their relations increases.

<sup>a</sup> Italic numbers in parentheses refer to Literature Cited, p. 81.

TABLE 12.—*Soil series of Graham County, N. C., classified by higher categories*

Order and great soil group	Series	Parent rock
<b>Zonal soils:</b>		
Red and Yellow Podzolic soils:	{ Habersham--	Sandstone, conglomerate, and graywacke.
Red Podzolic soils-----	{ Hiwassee---	Old alluvium.
Gray-Brown Podzolic soils:		
Soils with relatively thick B horizons.	{ Tusquitee--	Colluvium.
Soils with relatively thin B horizons (lithosolic).	{ State-----	Moderately recent alluvium.
	{ Porters-----	Graywacke, gneiss, and conglomerate.
<b>Azonal soils:</b>	{ Ramsey-----	Schist, shale, slate, quartzite, and sandstone.
Lithosols-----	{ Ranger-----	Slate.
	{ Congaree-----	Recent alluvium.
	{ Buncombe-----	Do.
<b>Alluvial soils-----</b>	{ Chewacla-----	Do.
	{ Wehadkee-----	Do.
	{ Toxaway-----	Do.

**MORPHOLOGY OF SOILS REPRESENTING GREAT SOIL GROUPS****ZONAL SOILS****RED PODZOLIC SOILS**

Red Podzolic soils of the Red and Yellow Podzolic great soil group are a zonal group of soils having thin organic and mineral-organic layers over a yellowish-brown leached layer that rests upon an illuvial red layer. They are developed under deciduous or mixed forest in a warm-temperate climate. The processes by which the soils were formed are podzolization and laterization (10, 5).

In Graham County the Red Podzolic soils are of very limited extent and include members of only two series—the Habersham and the Hiwassee. The Red Podzolic soils are well drained and their relief ranges from undulating to steep. There are relatively marked differences in the character of the material from which the soils of each series is derived, and such differences may be directly or indirectly the chief cause of differences in the soils. The Red Podzolic soils are in the lower lying parts of the county, the Hiwassee occurring on high terraces along streams and the Habersham on the valley uplands and lower slopes of mountains. Both series are in those parts of the county where the temperature is higher, and both are derived from rock materials that have been in place for a longer time than the parent materials of the Gray-Brown Podzolic soils at similar elevations.

In this county the Habersham soils are far more extensive than the Hiwassee. They have developed over siliceous rock, chiefly fine-grained sandstone and graywacke. Their slope ranges from 10 to 60 percent. The soils occur in both the valley and lower mountain up-

land regions, and to a large extent are associated with Ramsey and Porters soils. Their forest cover consists of mixed deciduous hardwoods intermingled with some pine.

Profile of Habersham loam, hilly phase, in a forested area :

- A. A very thin layer of leafmold and partly decomposed roots and twigs.
- A<sub>1</sub>. 0 to 5 inches, yellowish-brown friable loam; weak fine crumb structure; a considerable quantity of organic material.
- A<sub>2</sub>. 5 to 15 inches, dark-brown friable loam; moderate medium nut structure.
- B<sub>1</sub>. 15 to 26 inches, reddish-brown to brownish-red friable clay loam; moderate medium nut structure; a few small soft rock fragments.
- C. 26 inches +, reddish-brown clay loam mixed with soft partly weathered parent rock; underlying material, partly decomposed parent rock of gray sandstone or conglomerate.

The Hiwassee soils are on old high terraces and have comparatively deep profiles over gravelly beds or other sedimentary material. The surface soil, or A horizon, is dark-brown to reddish-brown friable silty clay loam. The subsoil, or B horizon, consists of reddish-brown to deep-red moderately compact friable clay loam or silty clay of moderate nuciform structure. The substratum, or C horizon, is orange or light-red to red, splotched with yellow and gray, friable soil material, in which are a few pieces of rounded gravel. The Hiwassee profile has a deeper red color and contains more clay than that of the Habersham.

#### GRAY-BROWN PODZOLIC SOILS

Gray-Brown Podzolic soils are a zonal group of soils having a comparatively thin organic covering and organic-mineral layers over a grayish-brown leached layer that rests on an illuvial brown layer developed under deciduous forest in a temperate moist climate. Podzolization is the dominant soil-forming process (10). Two subgroups are recognized in the Gray-Brown Podzolic great soil group in Graham County; namely, soils with relatively thick B horizons, and soils with relatively thin B horizons.

Tusquitee and State soils correlate fairly well as Gray-Brown Podzolic soils with relatively thick B horizons, although the climate under which they have developed apparently is similar to that under which the Red Podzolic soils have developed. The Tusquitee soils are many times more extensive than the soil of the State series. They developed from colluvial material, which in most places is at the foot of hilly or steep slopes.

Profile of Tusquitee silt loam, rolling phase, in a forested area :

- A. 0 to 3 inches, well-decomposed leafmold containing a large quantity of partly disintegrated twigs and roots.
- A<sub>1</sub>. 3 to 12 inches, dark-brown to brown very friable silt loam or loam; moderate medium crumb structure.
- B. 12 to 30 inches, yellowish-brown to brown loam to clay loam; friable and easily pervious to water and roots; weak medium nuciform structure.
- C. 30 inches +, yellowish-brown or brownish-yellow friable clay loam, splotched with brown, yellow, and gray and generally containing both flat-rounded and angular rock fragments.

Differences among the Gray-Brown Podzolic soils with relatively thick B horizons appear to be due mainly to differences in parent mate-

rials and relief. The State soil has formed from moderately recent alluvium on low terraces and is very similar to Tusquee soils in profile characteristics, but in many places is underlain by stratified alluvial material containing water-rounded gravel.

The Gray-Brown Podzolic soils with relatively thin B horizons have profiles resembling the Gray-Brown Podzolic soils with relatively thick B horizons, but are intermediate in degree of development between them and soils with a Lithosol profile. They are therefore said to be lithosolic soils. Most of the acreage is on steep and very steep slopes, and the lack of profile development is very likely the result of the strong relief. The Porters soils belong to this subgroup of the Gray-Brown Podzolic soils.

The Porters soils in this county are developed from material weathered from acid sedimentary rocks and highly metamorphosed gray-wacke. They are at notably higher altitudes than are the Red Podzolic soils or the Gray-Brown Podzolic soils with relatively thick B horizons. The subsoil, or B horizon, is much more open and permeable than that of the Habersham and Hiwassee soils, although these characteristics are common to the whole profile. The native forests consist of deciduous hardwoods mixed with some white pine.

Profile of Porters loam, steep phase, under native forest:

1. 0 to 3 inches, dark-brown organic loam; fairly large quantity of decomposed leaves, twigs, and roots; granular structure.
2. 3 to 6 inches, brown very friable loam; moderate fine crumb or soft granular structure.
3. 6 to 15 inches, brown to dark-brown friable porous loam or clay loam; weak medium nuciform structure.
4. 15 to 22 inches, yellowish-brown friable and porous loam or clay loam; medium nuciform structure; a few rock fragments.

#### AZONAL SOILS

In Graham County the azonal soil order is represented by the Lithosols and Alluvial soils great soil groups.

#### LITHOSOLS

Lithosols are azonal soils having no clearly expressed soil morphology and consisting of a freshly and imperfectly weathered mass of rock fragments, largely confined to steeply sloping land (10). Soils designated as Lithosols are generally steep and broken or severely eroded. They are very shallow over bedrock and have little if any genetic profile development. Geologic erosion almost keeps pace with the weathering of rock or rock material, so little true soil can develop. In some small areas zonal soils have formed with the azonal, but they are so inextensive they are not separated on the soil map.

The Ramsey and Ranger soils are classified as Lithosols. Soils of the Ramsey series, many times more extensive than the soil of the Ranger series, have formed over schist, sandstone, shale, slate, and quartzite on slopes ranging from 15 to over 60 percent. The native vegetation is mixed hardwood forest, which in many places on the southern slopes of mountains contains some white and shortleaf pines. In places on northern slopes, usually at elevations above 4,500 feet, hemlock, spruce, and balsam fir are growing.

**Profile of Ramsey shaly silt loam, steep phase, in a forested area :**

1. 0 to 1 inch, dark-brown loam; high percentage of organic matter.
2. 1 to 3 inches, light brownish-gray friable shaly silt loam; weak medium crumb structure.
3. 3 to 9 inches, brownish-yellow very friable shaly silt loam; moderate coarse crumb structure.
4. 9 to 17 inches, yellowish-brown to brownish-yellow very friable and shaly permeable silt loam or light silty clay loam; little or no structural development; in many places apparently transitional material between layer 3 and layer 5.
5. 17 to 25 inches, gray disintegrated rock mixed with weathered rock material; underlying bedrock, schist, sandstone, shale, quartzite, conglomerate, or slate.

The Ranger soil has formed on mountain uplands from weathered products of bluish-colored slate. It differs from Ramsey soils mainly in having a somewhat darker surface soil and finer texture throughout the soil mass.

Stony colluvium (Tusquitee soil material) and Stony rough land (Porters and Ramsey soil materials) are miscellaneous land types. Because of their close relation to the parent rock or parent material, they are classified as Lithosols. The stony colluvium consists chiefly of rounded or flat-rounded stone mixed with some soil material and shows little or no profile development. Stony rough land has steep, rugged, and rough relief and consists primarily of Porters and Ramsey soil materials. In places large boulders and outcrops of bedrock are numerous. In others the slopes are very steep, and bedrock is only a few inches below the surface.

#### ALLUVIAL SOILS

Alluvial soils consist of transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes (10). The Congaree, Buncombe, Chewacla, Toxaway, and Wehadkee series are classified in this great soil group.

The soil of the Congaree series is the most extensive of the group. It consists of more or less assorted, relatively fine-textured acid alluvium washed mainly from uplands underlain by igneous and metamorphic rocks. The soil has slow external drainage and moderate internal drainage. It is subject to flooding by the adjacent streams and to deposition or removal of material by overflow waters. Although practically all areas have been cleared and farmed at some time, the original trees probably consisted of mixed hardwoods, among which birch, beech, poplar, and maple predominated.

**Profile of Congaree silt loam in a cultivated area :**

1. 0 to 8 inches, grayish-brown to light-brown friable silt loam; moderate fine crumb structure.
2. 8 to 32 inches, brown to strong yellowish-brown smooth friable silt loam to light silty clay loam; weak granular structure.
3. 32 inches +, dark yellowish-brown silt loam to fine sandy loam; grades into materials of variable texture that range from beds of gravel and sand to laminated silt and clay.

The soil of the Buncombe series is distinguished from the Congaree by its extremely loose sandy nature and low content of clay. Throughout the profile the texture ranges from loamy fine sand to sand. The soil has very slow external drainage and rapid internal



drainage. The entire profile is lighter colored than the Congaree profile and is practically devoid of structure.

The soil of the Chewacla series differs from that of the Congaree series in having a mottled subsoil, very slow external drainage, and slow internal drainage. The profile to a depth of 7 to 12 inches is dark yellowish brown or brown. Brownish-gray silt loam mottled with brown and brownish black occurs below this depth to about 24 inches; it is underlain by gray silty clay loam spotted with reddish brown. Water is encountered at 20 to 30 inches in many places. Gravel and sand beds are generally at a depth of about 40 inches.

Wehadkee silt loam, the only member of the Wehadkee series mapped in this county, occurs in catenary relationship with Congaree and Wehadkee soils. In this relationship the Congaree is the well-drained soil, the Chewacla the imperfectly drained, and the Wehadkee the poorly drained.

Wehadkee silt loam, known locally as bulrush land, is associated with Chewacla silt loam. The 5- to 10-inch surface layer is brownish-gray silt loam with dark reddish-brown mottling up to near the top. Below this layer is gray, mottled with brownish-black or yellowish-brown, silt loam to silty clay that continues to a depth of about 30 inches. This mottled layer is underlain by sand, gravel, and clay. The water table lies at the top of this coarser material, although in some areas it is within 12 to 15 inches of the surface. During the wetter seasons, the entire profile is saturated with water.

The soil of the Toxaway series occurs in level or nearly level areas of some of the bottom lands. It has a dark-colored surface soil that contains a large quantity of organic matter. The subsoil is mottled light brown, brown, and gray, and is underlain by a layer of sand, gravel, and clay. The soil is poorly drained, and the layer of coarser material is permanently saturated with water. In some places the water table is within 20 inches of the surface. In places the Toxaway soil has developed to a very minor degree the characteristics of soils in the Half Bog great soil group. Half Bog soils have mucky surface soil underlain by gray mineral soil (10).

## SOIL SURVEY METHODS

In making a soil survey, the soils are examined, classified, and mapped in the field, and their characteristics reported (3). The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings are made, and highway, railroad, and other cuts studied. Each examination exposes a series of distinct soil layers, or horizons, termed collectively the soil profile. Each horizon, as well as the underlying parent material, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil, or its content of lime, is determined by simple tests.<sup>9</sup> Other

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<sup>9</sup>The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity (3). Indicator solutions or electric resistance units are used to determine the reaction. Refer to Acidity in the Glossary, p. 79, for terms applying to reaction and commonly used in this report.

features taken into consideration are drainage, both internal and external; relief, or lay of the land; and the interrelations of soil and vegetation.

The soils are classified according to their characteristics, both internal and external, and special emphasis is laid upon the features that influence the suitability of the land for the production of crop plants, grasses, and trees. On the basis of these characteristics, the soils are grouped in the section Soils of Graham County into a three-category classification, the categories being from highest to lowest: (1) Series, (2) type, and (3) phase.

The series is a group of soils having the same genetic horizons, similar in their important characteristics and arrangement in the profile, and having similar parent materials. Thus, the series comprises soils having essentially the same color, structure, natural drainage, and other important internal characteristics except those caused by accelerated erosion. The texture of the upper part of the soil, including that commonly plowed, may vary within the series. The series are given geographic names taken from localities near which they were first identified. Ramsey, Porters, Habersham, and Congaree are names of important soil series in Graham County.

Soil types are divisions of series and are distinguished from each other by differences in the texture of the upper part of the soil: in uneroded soils, of the surface or A layer; in eroded soils, of the plow layer. Soil type names consist of the soil series name to which is added the soil class name applying to the upper part of the soil, as loamy sand, sandy loam, clay loam. Thus, Tusquitee silt loam and Tusquitee stony loam are names of soil types of the Tusquitee series.

Soil phases, as used in this area, are subdivisions of soil types and are distinguished from each other by differences in slope or by differences in degree of erosion.

Soil phase names consist of the soil type name to which has been added the appropriate slope or the appropriate slope and erosion names, as undulating phase, eroded rolling phase, severely eroded steep, and so on. Thus, Tusquitee stony loam, eroded hilly phase, is the name of a phase of Tusquitee stony loam, which is the soil type.

In Graham County the types of relief and percent of slope range are as follows: (1) Level or nearly level, 0 to 2 percent; (2) undulating, 2 to 7 percent; (3) rolling, 7 to 15 percent; (4) hilly, 15 to 30 percent; (5) steep, 30 to 60 percent; and (6) very steep, 60 percent or more.

The classification followed in defining, naming, and mapping erosion phases is as follows:

1. *Eroded*.—Soils eroded to the extent that subsoil material is within plow depth over about half or more of the delineated area are classified and mapped as eroded. Ordinary tillage of this land will bring part of the upper subsoil to the surface, altering the character of the original surface soil, or A horizon, with an admixture of subsoil material. There may be a limited number of shallow, short gullies. It is usually estimated that 40 to 75 percent of the original A horizon has been lost from these eroded soils.

2. *Severely eroded*.—Soils eroded to the extent that practically all of the original surface soil has been lost are classified as severely eroded. In places some of the subsoil also has been lost. Tillage of severely eroded areas is almost entirely in subsoil material. Small short gullies, a few of which are too deep to be obliterated by tillage, are common.

The phase is the chief mapping unit. A few soil types, however, particularly those on first bottoms, do not have sufficient range in slope or erosion to justify recognizing more than one phase, and in such cases the phase designations are not used in the names. Thus, inasmuch as all Congaree silt loam is nearly level and uneroded, only the type designation, Congaree silt loam, is used.

Some areas that have no true soil are mapped as miscellaneous land types, as Stony rough land (Porters and Ramsey soil materials) and Stony colluvium (Tusquitee soil material).

The soil surveyor makes a map of the county, showing the location of each of the soil types, phases, and miscellaneous land types in relation to roads, houses, streams, lakes, and other cultural and natural features of the landscape.

Definitions of many unfamiliar soil terms used in the report are given in the glossary.

## GENERAL NATURE OF THE AREA

### LOCATION AND EXTENT

Graham County, in the extreme southwestern part of North Carolina bordering Tennessee (fig. 1), is bounded on the north and east

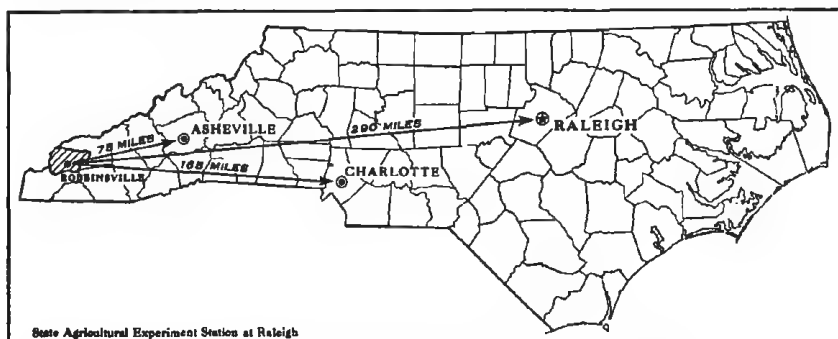


FIGURE 1.—Location of Graham County in North Carolina.

by Swain County, on the south by Cherokee County, and on the west by Tennessee. Macon County touches it at the southeast corner. Robbinsville, the county seat, located on Tulula Creek, is 75 miles southwest of Asheville and 290 miles southwest of Raleigh, the State capital. The boundaries of the county are irregular, for in most places they follow streams and the crests of mountain ridges. The total area is 296 square miles, or 189,440 acres.

### PHYSIOGRAPHY, RELIEF, AND DRAINAGE

The county lies in the southern part of the Appalachian Mountains within the Blue Ridge province of the Appalachian Highland (2). The landscape is characterized by mountain ranges with sharp narrow ridges and peaks and by extremely narrow valleys. The most con-

spicuous valley, that along the Cheoah River near Robbinsville, is less than one-half mile wide. The important mountain ranges are Unicoi, Snowbird, and Cheoah Mountains.

Elevations<sup>10</sup> above sea level vary widely in different parts of the county. The highest points are Huckleberry Knob, 5,560 feet, and Haw Knob, 5,472. Other points having elevations above 5,000 feet are Hooper Bald, 5,429; Little Huckleberry Knob, 5,400; Stratton Bald, 5,400; Laurel Top, 5,350; Little Haw Knob, 5,146; and Cheoah Bald, 5,062. Almost two-fifths of the county occurs on slopes greater than 60 percent, and over two-fifths is on slopes ranging between 30 and 60 percent. The elevations of some of the towns are: Robbinsville, 2,064 feet; Stecoah, 2,022; Cheoah, 2,212; and Tapoco, 1,147.

Except for some inextensive level areas in the first bottoms, the county is well drained. On the hilly uplands and the mountain slopes runoff is excessive. The county is drained by the Little Tennessee River and its tributaries. The Cheoah River, the principal stream flowing across the county, is fed by Santeetlah, Yellow, West Buffalo, Snowbird, Sweetwater, and Tulula Creeks. Tuskegee, Sawyer, Stecoah, and Wolf Creeks flow into the Little Tennessee River. Creeks, branches, and streamlets extend into all sections. Every farm has one or more of these drainage outlets.

### GEOLOGY

The upland soils have developed in place from the weathering of local geologic formations, primarily sedimentary rocks of the Cambrian age that have been highly metamorphosed. These formations are in what has been called the Ocoee group and include Great Smoky conglomerate, Nantahala slate, Brasstown schist, and Tusquitee quartzite (11).

The Great Smoky conglomerate contains a considerable variety of strata, composed of conglomerate, sandstone, quartzite, graywacke, mica schist, granite schist, and slate. All of these rocks, except the slate, have a decidedly gray color that becomes whitish with exposure and weathering of the feldspars they contain. Most of the schists are micaceous and strongly resemble those of Carolina gneiss. Frequently they are filled with small crystals of garnet and ottrelite. The rocks of this formation are resistant to erosion, a fact which accounts to a large extent for the rugged mountain relief. Areas of Great Smoky conglomerate may be found throughout the northern and western parts of the county.

Nantahala slate occurs in the vicinity of Tulula and Round Top. This formation is composed in the main of black-and-gray banded slate and of schist distinguished by mica, garnet, staurolite, or ottrelite. The slate and schist are, as a rule, somewhat darker than the other beds, the color being due to minute grains of iron oxide. In places many sandstone and conglomerate beds are interstratified with the slate, especially near its base, and form a transition into the

<sup>10</sup> Elevation data from the following U. S. Geological Survey topographic maps: Santeetlah Creek, N. C., Quadrangle; Big Junction, Tenn.-N. C., Quadrangle; Hewitt, N. C., Quadrangle; Robbinsville, N. C., Quadrangle; and Tapoco, N. C.-Tenn., Quadrangle. 1940.

Great Smoky conglomerate formation. The decay of this formation is very slow because it has so few soluble constituents.

Brasstown schist in greater part consists of banded ottrelite schist and slate. All of the schist and slate of the formation are dark, varying from dusky blue to bluish brown and dark gray. They are nearly always marked by a fine banding of light gray and dark colors. The light-gray layers are highly siliceous and occasionally grade from sandy slate into seams of light-gray sandstone. Under the influence of weathering the resistance of the rocks within the formation varies considerably. The less altered slates are readily reduced and form low hilly ground, the rock breaking down into slabs. Ottrelite schist yields much more slowly and decay is never deep. Areas of Brasstown schist occur near Teyahalee Bald and Swim Bald. This formation, however, is inextensive, and not important.

Tusquitee quartzite, the smallest of the formations mentioned, includes a white quartzite occurring as very narrow elongated areas. It is closely associated with Nantahala slate and Brasstown schist.

### CLIMATE

The climate of the county is temperate and continental; according to Koppen's classification it is warm temperate (9). There is no distinct dry season; summers are mild with cool pleasant evenings and high rainfall. The average temperature of the warmest month is under 74° F. Winters are moderate but are characterized by short erratic cold spells.

Precipitation is well distributed throughout the year (4) and ample for the crops grown. Locally precipitation and temperature may vary widely because of great differences in elevation. On the higher mountains precipitation is much heavier and the temperature considerably lower than in the valleys. Rainfall often comes as flash storms in summer, spring, and fall; but gentle, slow rains are also common. In winter the precipitation falls as even, slow rain or as snow. Severe droughts are uncommon, but dry spells in summer and early in fall often decrease crop yields.

The average date of the last killing frost in spring is April 25; that of the first in fall, October 16. Thus the average frost-free period is 173 days. The latest recorded killing frost in spring was May 17, and the earliest in the fall, October 2.

Normal monthly, annual, and seasonal temperatures and precipitation data compiled from records at the United States Weather Bureau station at Andrews, Cherokee County, N. C., are given in table 13 as representative of climatic conditions in Graham County.

### WATER SUPPLY

The many streams in the county furnish abundant water for livestock (pl. 3). Excellent spring water for domestic use is available on most farms, and if well water is needed it can be obtained at various depths, usually within 40 feet. Artificial lakes provide recreation as well as water power. Hydroelectric plants (6) that derive their power from Cheoah and Fontana Lakes on the Little Tennessee River and Santeetlah Lake on the Cheoah River furnish great quantities of power (pl. 4, A). The Fontana development is one of the



Clear rapidly flowing perennial streams in Graham County furnish abundant water for livestock and household use, provide power, and attract fishermen and admirers of natural beauty. (Courtesy of TVA.)



**A,** Santeetlah Lake on the Cheoah River in the central part of Graham County is a privately owned hydroelectric development covering 2,850 acres. Many of the larger streams in the county furnish power for public and private use. (Courtesy of TVA.)

**B,** Original deciduous trees in Joyce Kilmer Memorial Forest. Little timber of this kind remains in Graham County. (Courtesy of TVA.)

largest in the eastern part of the United States and has the highest dam east of the Rocky Mountains. Small sawmills and gristmills on many creeks are operated by water power, and considerably more hydroelectric power could be developed on some of the streams such as Yellow, Wolf, and Atoah Creeks.

TABLE 13.—*Normal monthly, seasonal, and annual temperature and precipitation at Andrews, Cherokee County, N. C.*

[Elevation 1,800 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year	Total for the wettest year	Average snow-fall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	42. 0	73	—1	6. 80	2. 30	16. 83	2. 1
January.....	41. 2	78	—6	5. 40	5. 49	6. 88	2. 5
February.....	42. 3	80	—4	5. 50	1. 80	9. 83	2. 6
Winter.....	41. 8	80	—6	17. 70	9. 59	33. 54	7. 2
March.....	48. 7	86	6	6. 60	2. 90	5. 44	2. 6
April.....	56. 9	88	15	4. 70	3. 30	4. 52	( <sup>1</sup> )
May.....	64. 0	95	27	5. 00	3. 30	3. 01	0
Spring.....	56. 5	95	6	16. 30	9. 50	12. 97	2. 6
June.....	71. 0	99	38	5. 10	5. 00	5. 36	0
July.....	73. 8	99	44	6. 10	5. 20	6. 16	0
August.....	73. 0	98	44	5. 00	2. 30	4. 16	0
Summer.....	72. 6	99	38	16. 20	12. 50	15. 68	0
September.....	69. 5	95	33	3. 80	1. 30	3. 71	0
October.....	57. 9	90	18	3. 40	6. 00	6. 63	( <sup>1</sup> )
November.....	47. 4	83	8	4. 00	4. 80	5. 04	. 4
Fall.....	58. 3	95	8	11. 20	12. 10	15. 38	. 4
Year.....	57. 3	99	—6	61. 40	<sup>2</sup> 43. 69	<sup>3</sup> 77. 57	10. 2

<sup>1</sup> Trace.

<sup>2</sup> In 1925.

<sup>3</sup> In 1932.

### VEGETATION

The county lies within three subdivisions of the eastern forest region as follows: (1) Birch-beech-maple-hemlock (northeastern hardwoods), (2) chestnut-chestnut oak-yellow poplar of the oak (southern hardwood forest), and (3) spruce-fir (northern coniferous forest) (8).

The original tree growth consisted of chestnut, oak, hemlock, maple, birch, yellow-poplar, hickory, walnut, cherry, buckeye, and a few pines. Spruce and balsam were on the highest mountains. Most of these stands have been cut, but a few areas such as the Joyce Kilmer



Memorial Forest (pl. 4, *B*) still have some virgin timber. Oak, maple, yellow-poplar, locust, pine, hemlock, beech, birch, and hickory have come in as second and third growth, and considerably more pines are in the present stand than in the original. All the chestnut trees were killed by blight prior to 1930, but many dead trees are still standing and some are being cut for acid wood and pulpwood.

Intermixed with the original forest was an undergrowth of shrubs and small patches of grass, and other plants. The shrubs consisted chiefly of rhododendron, mountain-laurel, sourwood, dogwood, huckleberry, buckberry, gooseberry, and sassafras.

Cultivated lands no longer used soon grow up in weeds, broom-sedge, and briars. Within a period of 3 or 4 years white pine or shortleaf pine and black locust have become established on the drier sites and yellow-poplar on the moister areas. Except on severely eroded areas the trees grow rapidly and make a good stand within a few years.

### ORGANIZATION AND POPULATION

Graham County, named in honor of William A. Graham, a former governor of North Carolina, was formed in 1872 from a part of Cherokee County (7). Most of the first white settlers, from whom nearly all of the present population is descended, were natives of North Carolina, coming mainly from Haywood and other counties to the east. They were chiefly of Scotch, Irish, and English extraction. Several Indian families still live in the county.

In 1950 the population was 6,886, or 23.8 persons a square mile. All of the population is classed as rural. Practically all the people live in the stream valleys; few are in the remote mountain areas.

Robbinsville, the county seat, with a population of 515 in 1950, is an important trading and shipping point for the southern part of the county, especially for lumber, pulpwood, and acid wood. Other small villages and trading points are Stecoah, Cheoah, and Tapoco.

### INDUSTRIES

In addition to selling farm produce, the people in the county derive considerable income from the sale of large quantities of timber, tanbark, acid wood, pulpwood, and cross ties. In 1938 there were six sawmills in the county, one having a capacity between 20,000 and 39,000 board feet a day, another with a capacity between 10,000 and 19,000 board feet, and four having a capacity between 1,000 and 9,000 board feet a day (1). Three hydroelectric power plants also furnish some employment. Few, if any, minerals are produced within the county. Some amphibole asbestos occurs near the Macon and Swain County lines. The mineral resources of the area have not been surveyed thoroughly.

### TRANSPORTATION FACILITIES

One hard-surfaced highway crosses the county from southeast to northwest, and one from northeast to south. A few logging roads and farm roads extend from these two main roads. It is not unusual for the secondary roads to become impassable during very rainy weather. The only railroad in the county connects Robbinsville with

the Southern Railway system at Topton. Because of these limited facilities transportation of products from the county is expensive and time consuming. Transportation costs, even to the nearest markets, are high. The distance by motortruck is great and several mountains have to be crossed before a large market is reached; shipment by train requires considerable time.

### COMMUNITY AND FARM FACILITIES

One high school and several primary schools are in the county. Busses furnish transportation to and from school, but many children have to walk several miles to a bus route. Some of those attending high school must spend 2 to 4 hours a day traveling to and from school. Most of the schools, as well as the busses, are overcrowded. Churches are widely located throughout the county and within convenient distance to most homes. School buildings and churches are available for agricultural meetings and social gatherings. The county has seven post offices, and most of the communities are served by rural mail routes.

Dwellings, for the most part, are in reasonably good repair; about half are painted, nearly all have electric lights, and a few have running water. Some dwellings in the more remote sections and in the Indian communities need much repair or should be replaced. Most outbuildings are small; some are not very well kept. Fences are relatively new and in fair condition because until recently much of the county was open range.

Telephones were reported on only 20 farms in 1950, but in the same year 510 farms were reported as using electric current. In 1950 there were 200 automobiles, 160 motortrucks, and 30 tractors on farms.

### AGRICULTURE

Agriculture has been the principal occupation in Graham County since the days of settlement. Even the Cherokee Indians, who lived mainly on game, produced some corn, barley, tobacco, and pumpkins on the bottom lands. The first white settlers grew subsistence crops, as wheat, potatoes, corn, and hay, in small tracts they cleared and farmed until the natural fertility was practically exhausted. Then other areas were cleared, and the old fields were abandoned and left to grow up in trees. The production of hay and other feed crops has increased gradually with the increase in the number of livestock.

The county continued as open range until recently. Grazing by cattle and hogs was important because the animals could live on the open range and be driven to the markets or slaughtered at home for meat. Tobacco has been grown since the organization of the county in 1872, but on a small scale and, until recently, mainly for local consumption. Until the development of the highway system during the last 25 years, transportation difficulties greatly retarded agricultural development. Owing to transportation costs and distance to markets, agriculture almost necessarily has been on a subsistence basis.

Most of the land suitable for agriculture has been cleared and is being farmed. Because of its steepness and susceptibility to erosion much of the cleared land is poorly suited to tilled crops and will not provide an income for many families. Were it not for the timber

industry, the population probably would be considerably smaller.

No one crop dominates. Certain cash crops seem to be grown within small neighborhoods, not because of soil conditions but because of individual preference in type of farming. The principal crops are corn, wheat, oats, rye, peas, soybeans, potatoes, tobacco, and hay. Some fruit, especially apples and peaches, is produced for home use but none is grown on a commercial scale.

On almost every farm garden vegetables are grown for home consumption. Most farms have a few head of cattle, a small flock of chickens, one to three head of hogs, and from one to two work animals. Sheep have steadily decreased in number, and now are raised on only a few farms.

The agriculture of the county depends largely on a few soils that have developed in less sloping areas. These soils are members of the Tusquitee, Buncombe, Chewacla, Congaree, Hiwassee, State, and Habersham series. Most of the crops may be grown on other soils but they cannot be grown continuously except on soils of these series. Steeper lands are used chiefly for pasture or left in forest. Farmers having only a small acreage of relatively smooth land and a considerable acreage of steep land generally plan intensive cultivation for the smoother slopes and pasture and an occasional crop for the steeper slopes. Under this system it is easier to control water on the land. On many farms, however, there is only hilly or steep land and the loss of soil material by erosion is high because runoff is difficult to control.

### CROPS

The acreage of the principal crops and numbers of fruit trees and grapevines in various years are shown in table 14.

#### CORN

Corn, the most important crop, is grown on practically every farm regardless of the suitability of the soils. It is fed to livestock or ground for household use. A small quantity—not enough to supply local demands—is sold on local markets. The acreage in corn has decreased steadily since 1919. The best yields of corn are usually obtained on the bottom lands, stream terraces, and colluvial slopes.

#### SMALL GRAINS

The acreage of wheat has decreased sharply since 1919. No acreage of wheat or oats was reported in the census for 1929 and 1939. Rye is planted as a cover crop or to provide grazing late in winter and early in spring, but the acreage has never been large.

#### HAY AND FORAGE

Hay occupies the second largest acreage in the county. It is grown on most of the soils that can be planted to field crops. Most of the farms produce enough hay for the work animals and cattle, but few have any to sell. Red clover was formerly grown to a much greater extent than now. The decrease in acreage probably results from lowered yields caused by leaching of plant nutrients and organic matter from the soils and the loss of soil material through erosion. Lespedeza has to some extent replaced clover, but with use of lime,

fertilizer, organic matter, and improved seed, clover can be grown successfully. Lespedeza and Austrian winter peas were introduced recently. The acreage of peas is small.

TABLE 14.—*Acreage of the principal crops and numbers<sup>1</sup> of fruit trees and grapevines in Graham County, N. C., in stated years*

Crop	1919	1929	1939	1949
	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
Corn.....	6, 447	<sup>2</sup> 4, 088	<sup>2</sup> 3, 837	<sup>2</sup> 2, 599
Wheat.....	307	( <sup>3</sup> )	( <sup>3</sup> )	15
Oats.....	123	( <sup>3</sup> )	( <sup>3</sup> )	( <sup>3</sup> )
Rye.....	855	161	34	18
Peas (dry).....	237	( <sup>3</sup> )	21	1
Soybeans.....	30	( <sup>3</sup> )	2	1
All hay.....	1, 445	1, 545	1, 070	1, 708
Annual legumes.....	45	21	44	15
Timothy and clover.....	70	1	105	282
Lespedeza and sweetclover.....	( <sup>3</sup> )	10	123	<sup>4</sup> 101
Grains cut green.....	22	1	55	27
Sorghums for hay.....	59	( <sup>3</sup> )	5	( <sup>3</sup> )
Other tame hay.....	678	870	587	1, 283
Wild hay.....	571	642	151	( <sup>3</sup> )
Corn for silage.....	823	4	15	13
Potatoes.....	247	163	255	138
Sweetpotatoes and yams.....	80	85	102	15
Other vegetables.....	( <sup>3</sup> )	20	3	( <sup>3</sup> )
Tobacco.....	10	18	154	281
Sorghum for sirup.....	112	20	15	( <sup>3</sup> )
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Apple.....trees.....	14, 857	13, 591	14, 457	10, 311
Peach.....do.....	4, 305	4, 780	3, 555	109
Pear.....do.....	54	74	174	62
Plum and prune.....do.....	713	507	475	53
Cherry.....do.....	227	401	589	374
Grapevines.....	337	558	1, 010	1, 108

<sup>1</sup> Number of bearing fruit trees and grapevines.

<sup>2</sup> Harvested for grain.

<sup>3</sup> None reported.

<sup>4</sup> Lespedeza total only.

#### POTATOES

The acreage in potatoes has fluctuated but has shown no definite trend toward increase or decrease. Some potatoes are sold on local markets, but most of the crop is stored on farms and consumed during winter and spring. The acreage in sweetpotatoes, which are grown in home gardens, has gradually increased.

#### TOBACCO

Tobacco is the main cash crop. The land area in this crop has increased from 18 acres in 1929 to 281 acres in 1949. More careful selection of seed and soils and use of better fertilization practices probably are responsible for the increased yields and acreage of this crop. Before 1930 most of the tobacco was consumed locally and only a small quantity found its way to outside markets.

## FRUITS AND VEGETABLES

The acreage used for cabbage, snap beans, peas, and other vegetables is limited. Some fruits and berries are produced on most farms. Apples are the main tree fruit. Some strawberries are grown, and wild huckleberries, dewberries, and blackberries are usually harvested. Small quantities of the fruits and vegetables are sold; they are used fresh or canned or processed by the farm family.

## PERMANENT PASTURE

Compared with that in other counties, the acreage of permanent pasture is small—2,621 acres of plowable pasture, 6,898 acres of woodland pasture, and 3,374 acres of other pasture in 1949.

## FOREST PRODUCTS

Forest covers about 160,000 acres in the county, and considerable income is derived from sale of forest products. Much of the county is covered with second- or third-growth forest, but some virgin timber remains, particularly in the southern and southwestern parts.

## LIVESTOCK

Cattle raising is the most important livestock enterprise in the county; poultry and hog raising, respectively, rank second and third. The number of cattle has remained fairly constant—1,983 head in 1950, 2,151 head in 1940, and 2,325 head in 1930. The number of swine decreased from 1,827 in 1930 to 954 in 1950; sheep, from 1,517 to 17; and mules, from 279 to 125. During the same period horses increased from 330 to 449. Cattle are fed little grain, but most of the hogs are fattened on it, and some grain is fed to chickens. Some hogs are allowed to run in the woods and feed on mast.

Quantities of livestock products produced and sold by farms are listed in table 15 for stated years.

TABLE 15.—*Specified livestock products produced or sold by farms in Graham County, N. C., in stated years*

Livestock products	1919	1929	1939	1949
Chickens raised.....number..	26, 203	28, 738	28, 591	<sup>1</sup> 25, 259
Chickens sold.....do.....	9, 832	8, 084	7, 849	12, 003
Eggs produced.....dozens....	44, 567	81, 588	80, 174	( <sup>2</sup> )
Eggs sold.....do.....	14, 763	26, 681	( <sup>2</sup> )	44, 998
Cows milked.....number.....	( <sup>2</sup> )	907	987	670
Milk produced.....gallons....	299, 423	333, 773	426, 980	( <sup>2</sup> )
Milk sold.....do.....	1, 507	3, 479	8, 671	34, 961
Cream sold.....do.....	2	( <sup>2</sup> )	5	80
Butterfat sold.....pounds....	649	( <sup>2</sup> )	( <sup>2</sup> )	( <sup>2</sup> )
Butter churned.....do.....	99, 901	97, 047	107, 263	( <sup>2</sup> )
Butter sold.....do.....	1, 242	4, 022	2, 726	( <sup>2</sup> )
Honey produced.....do.....	10, 488	2, 603	3, 282	( <sup>2</sup> )
Sheep shorn.....number.....	1, 104	919	99	8
Wool produced.....pounds....	2, 805	2, 541	318	24

<sup>1</sup> 4 months old and over.

<sup>2</sup> None reported.

## TYPE, SIZE, AND TENURE OF FARMS

In 1950 there were 199 classified farms in the county, and 560 farms unclassified. Classified by major source of income from products produced primarily for sale, 199 farms were grouped as follows: 174 field crops, 8 livestock, 9 dairy, 4 poultry, 4 general, and 4 crops and livestock.

Land in farms totaled 41,656 acres in 1950, or 22.5 percent of the county area. Of the total land in farms, however, only 5,315 acres were cropland harvested in 1949. Cropland—including cropland harvested, idle, fallow, or used for pasture—averaged only 12.3 acres per farm in 1949. As reported for that year, the average farm was 54.9 acres in size.

In 1949 most of the farms were less than 100 acres in size; 63 percent were under 50 acres and 43 percent under 30 acres. Approximately 29 percent of the farms were between 10 and 29 acres in size. Only 16 farms were larger than 260 acres, but 109 were less than 10 acres.

Owners operated 93 percent of the farms in 1949, and tenants 7 percent.

## GLOSSARY

**Acidity.** The degree of acidity of the soil mass expressed in pH values, or in words as follows:

Extremely acid..... below 4.5	Slightly acid..... 6.1-6.5
Very strongly acid..... 4.5-5.0	Neutral..... 6.6-7.3
Strongly acid..... 5.1-5.5	Mildly alkaline..... 7.4-8.0
Medium acid..... 5.6-6.0	

**Alluvial soils.** An azonal group of soils, developed from transported and relatively recently deposited material (alluvium) characterized by a weak modification (or none) of the original material by soil-forming processes.

**Alluvium.** Fine material, as sand, mud, or other sediments deposited on land by streams.

**Bedrock.** The solid rock underlying soils.

**Colluvium.** Deposits of rock fragments and soil material accumulated at the base of slopes through the influence of gravity. It includes creep and local wash and in many areas is of relatively mixed character.

**Consistence.** A soil term expressing degree of cohesion and the resistance to forces tending to deform or rupture the aggregate. The relative mutual attraction of the particles in the whole mass, or their resistance to separation. Terms commonly used to describe consistence include brittle, compact, firm, friable, plastic, sticky, and stiff.

**Brittle.** Term used to describe a soil that when dry breaks with a sharp, clean fracture, or if struck a sharp blow, shatters into cleanly broken hard fragments.

**Compact.** Dense and firm but without cementation.

**Firm.** Resistant to forces tending to produce rupture or deformation.

**Friable.** Readily ruptured and crushed with application of moderate force.

**Plastic.** Readily deformed without rupture; friable but cohesive; can be readily molded; puttylike.

**Sticky.** Adhesive rather than cohesive when wet, but usually very cohesive when dry. When wet, soil shows a decided tendency to adhere to other material and objects.

**Stiff.** Resistant to deformation or rupture; firm and tenacious and tending toward imperviousness. Usually applied to condition of the soil when in place and moderately wet.

**Erosion.** The wearing away or removal of soil material by water or wind.

**Fertility.** The capacity of a soil to supply nutrients in the amounts, kinds, and proportions needed for growth of specified plants when all other factors are provided.

- First bottom.** The normal flood plain of a stream; land along the stream subject to overflow.
- Horizon, soil.** A layer or part of the soil profile approximately parallel to the land surface with more or less well defined characteristics.
- Horizon, A.** The upper layer of the soil mass, from which material has been removed by percolating waters; the eluviated part of the solum; the surface soil. It is generally divided into two or more subhorizons of which  $A_1$  is not a part of the mineral soil, but the accumulation of organic debris on the surface. Other subhorizons are designated as  $A_1$ ,  $A_2$ , and so on.
- Horizon, B.** The layer of deposition, to which materials have been added by percolating waters; the illuviated part of the solum; the subsoil. This horizon may also be divided into several subhorizons, depending on the color, structure, consistence, or the character of the material deposited, and designated as  $B_1$ ,  $B_2$ , and  $B_3$ , and so on.
- Horizon, C.** The layer of partly weathered material underlying the B horizon; the substratum; usually part of the parent material.
- Mottled (mottling).** Containing irregular spots of different colors.
- Normal soil.** A soil having a profile in equilibrium with the two principal forces of the environment—native vegetation and climate—usually developed on the gently undulating (but not strictly level) upland, with good drainage, from any parent material not of extreme texture or chemical composition that has been in place long enough for biological forces to exert their full effect.
- Permeable.** Easily penetrated, as by water.
- Phase.** A subdivision of the soil type covering variations within the type that are insufficient to justify the establishment of a new type, yet are worthy of recognition; a mapping unit. The variations are chiefly in such external characteristics as relief, stoniness, or erosion. (Examples: Porters loam, steep phase, and Porters loam, eroded steep phase.)
- Productivity.** The capability of a soil to produce a specified plant (or plants) under a given system of management.
- Profile, soil.** A vertical section of the soil, from the surface into the parent material.
- Reaction.** See Acidity.
- Series, soil.** A group of soils having the same profile characteristics—same general range in color, structure, consistence, and sequence of horizons—the same general conditions of relief and drainage, and usually a common or similar origin and mode of formation. A group of soil types closely similar in all respects except the texture of the surface soil.
- Soil.** A natural body occurring on the surface of the earth characterized by layers resulting from modification of parent material by physical, chemical, and biological forces through various periods of time.
- Structure, soil.** The morphological aggregates in which the individual soil particles are arranged. It may refer to their natural arrangement in the soil when in place and undisturbed or at any degree of disturbance. Terms as prismatic, nutlike, nuciform, columnar, platy, crumb, granular, and massive are used to describe soil structure.
- Subsoil.** Technically, the B horizon; roughly, that part of the profile below plow depth.
- Substratum.** Material underlying the subsoil.
- Surface soil.** Technically, the A horizon; commonly, the part of the upper profile usually stirred by plowing.
- Terrace (geologic).** An old alluvial plain, usually flat or smooth, bordering a stream; frequently called second bottoms as contrasted to the flood plains; seldom subject to overflow.
- Texture.** Size of individual particles making up the soil mass. The various soil separates are the size groups, as sand, silt, and clay. A coarse-textured soil is one high in sand; a fine-textured soil has a large proportion of clay.
- Type.** A group of soils having genetic horizons similar as to differentiating characteristics, including texture and arrangement in the soil profile, and developed from a particular type of parent material.
- Upland (geologic).** Lands consisting of material unworked by water in recent geologic time and lying in general at higher elevations than the alluvial plain or stream terrace.

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GRAHAM COUNTY, NORTH CAROLINA, SOILS: SUMMARY OF IMPORTANT CHARACTERISTICS

Soil	Map symbol	Source of parent material	Slope	Drainage		Surface soil		Subsoil		Land class	Management group
				External	Internal	Color <sup>1</sup>	Consistence <sup>2</sup>	Color	Consistence		
Buncombe loamy fine sand	BA	Recent alluvium	Percent 0-3	Very slow	Rapid	Brown	Loose	Yellowish brown	Loose	Third	3-A
Chewacla silt loam	CA	do	0-3	do	Slow	Dark yellowish brown.	Friable	Brownish gray mottled with brown and brownish black.	Friable when moist; plastic and sticky when wet.	Second	2-B
Congaree silt loam	Cn	do	0-2	Very slow to slow	Moderate	Light brown	do	Yellowish brown	Friable	First	1-B
Habersham loam: Eroded hilly phase	HA	Siliceous rocks	10-30	Rapid	do	Brown to reddish brown.	do	Light red to brownish red.	do	Fourth	4-A
Eroded steep phase	Hb	do	30-60	Rapid to very rapid.	do	do	do	Strong brown to light red.	do	Fifth	5
Hilly phase	Hc	do	15-30	Moderate to rapid	do	Brown to dark brown.	do	Light red to brownish red.	do	Fourth	4-B
Severely eroded hilly phase.	Hd	do	15-30	Rapid	do	Light reddish brown to brownish red.	do	Strong brown to light red.	do	do	4-A
Steep phase	He	do	30-60	do	do	Moderate brown	do	do	do	Fifth	5
Hiwassee silty clay loam: Eroded hilly phase	Hf	Old alluvium	15-30	do	Moderate to slow	Dark brown	do	Dark reddish brown.	Stiff, brittle, but crumbly.	Third	3-B
Eroded rolling phase	Hg	do	4-15	Moderate to rapid	do	do	do	do	do	Second	2-C
Porters loam: Eroded hilly phase	PA	Acid sedimentary rocks.	15-30	Rapid	Moderate	Light brown	do	Moderate brown	Friable	Fourth	4-A
Eroded steep phase	Pb	do	30-60	Rapid to very rapid.	do	do	do	Yellowish brown	do	do	4-A
Hilly phase	Pc	do	15-30	Moderate to rapid	do	Brown to dark brown.	do	Moderate brown	do	Third	3-B
Steep phase	Pd	do	30-60	Rapid to very rapid.	do	Light brown to brown.	do	Yellowish brown	do	Fourth	4-B
Porters stony loam: Eroded hilly phase	Pe	do	15-30	Moderate to rapid	do	Light brown	do	Moderate brown	do	do	4-D
Eroded steep phase	Pf	do	30-60	Rapid	do	Light brown to brown.	do	do	do	Fifth	5
Hilly phase	Pg	do	15-30	Moderate to rapid	do	Brown	do	do	do	Fourth	4-C
Steep phase	Ph	do	30-60	Rapid	do	Light brown to brown.	do	Brown to light yellowish brown.	do	Fifth	5
Ramsey shaly silt loam: Eroded hilly phase	RA	Shale, slate, and sandstone.	15-30	Moderate	Rapid	Yellowish gray	do	Dusky yellow	do	do	5
Eroded steep phase	Rb	do	30-60	Rapid to very rapid.	do	Light brownish gray.	do	do	do	do	5
Hilly phase	Rc	do	15-30	Moderate	do	Light gray or yellowish gray.	do	do	do	do	5
Steep phase	Rd	do	30-60	Rapid to very rapid.	do	Weak brown to pale brown.	do	Moderate brown	do	do	5
Ramsey silt loam: Eroded steep phase	Re	do	30-60	do	do	Light brownish gray.	do	Dusky yellow	do	do	5
Hilly phase	Rf	do	15-30	Moderate	do	Light brown	do	Moderate brown	do	Fourth	4-B
Steep phase	Rg	do	30-60	Rapid	do	Light brownish gray.	do	Dusky yellow	do	Fifth	5
Ranger slaty silt loam, steep phase.	RH	Slate	30-60	do	do	Brownish gray	do	Light olive or brownish gray.	do	do	5
State silt loam, undulating phase.	SA	Moderately recent alluvium.	4-7	Very slow to slow	Moderate	Light brown	do	Moderate yellowish brown.	do	First	1-A
Stony colluvium (Tusquitee soil material).	Sa	Colluvium and recent alluvium.	2-30	Slow to moderate	Moderate to rapid	Brown	do	Brownish yellow or yellowish brown.	do	Fourth	4-E
Stony rough land (Porters and Ramsey soil materials).	Sc	Mixed rocks	30-90	Very rapid	Moderate	( <sup>3</sup> )	( <sup>3</sup> )	( <sup>3</sup> )	( <sup>3</sup> )	Fifth	5
Toxaway silt loam	TA	Recent alluvium	0-3	Slow to very slow	Very slow	Brownish black	Friable	Mottled light brown, brown, and gray.	Sticky to slightly plastic.	Second	2-B
Tusquitee silt loam: Hilly phase	Tb	Colluvium	15-30	Moderate	Moderate	Weak brown	do	Moderate brown	Friable	Third	3-B
Rolling phase	Tc	do	7-15	Slow	do	Light brown to dark brown.	do	Brown to dark brown.	do	First	1-A
Undulating phase	Td	do	2-7	Very slow to slow	do	Brown to dark brown.	do	Moderate brown	do	do	1-A
Tusquitee stony loam: Eroded hilly phase	Te	do	15-30	Moderate to rapid	do	Light brown to moderate brown.	do	do	do	Fourth	4-D
Hilly phase	Tf	do	15-30	do	do	Brown	do	do	do	do	4-C
Rolling phase	Tg	do	7-15	Moderate	do	Light brown to dark brown.	do	Brown to dark brown.	do	Second	2-A
Undulating phase	Th	do	2-7	Very slow to slow	do	do	do	do	do	do	2-A
Wehadkee silt loam	WA	Recent alluvium	0-2	Very slow	Very slow	Brownish gray mottled with dark reddish brown.	do	Mottled gray and brownish black or yellowish brown.	Friable, slightly plastic and sticky.	Fourth	4-E

<sup>1</sup> Color in eroded areas is the color to plow depth.<sup>2</sup> When soil is moist.<sup>3</sup> Chiefly stones.



